Dissertation on

PROSPECTIVE COMPARISON OF INTUBATING CONDITIONS WITH AIRTRAQ LARYNGOSCOPE AND MACINTOSH LARYNGOSCOPE IN RANDOMLY SELECTED ELECTIVE ADULT SURGICAL PATIENTS

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CERTIFICATE

This is to certify that the dissertation entitled**, "PROSPECTIVE COMPARISON OF INTUBATING CONDITIONS WITH AIRTRAQ LARYNGOSCOPE AND MACINTOSH LARYNGOSCOPE IN RANDOMLY SELECTED ELECTIVE ADULT SURGICAL PATIENTS"** submitted by Dr. ARAVIND KUMAR. P in partial fulfillment for the award of the degree of Doctor of Medicine in Anaesthesiology by the Tamilnadu Dr.M.G.R. Medical University, Chennai is a bonafide record of the work done by him in the Institute of Anaesthesiology and Critical Care, Madras Medical College, during the academic year 2008 – 2011.

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CONTENTS

INTRODUCTION

Tracheal intubation using a laryngoscope is considered to be the Gold standard[1] of airway management during administration of general anaesthesia and in critical care settings because of its several advantages including

- Allows delivery of anaesthetic gases and oxygen via positive pressure ventilation without inflation of stomach
- Isolation of the respiratory tract from GI system and hence minimal risk of aspiration
- Access to tracheobronchial tree for pulmonary hygiene and drug administration(e.g.inhaled bronchodilators)
- Improved surgical access to head and neck.

Airway management is important in anaesthesia because adverse respiratory events are responsible for 75% of ASA closed claims[2]. Of these inadequate ventilation is the main culprit(38%), followed by oesophageal placement of tracheal tube(17%) and difficult intubation(18%). Approximately 600 patients[3] die each year in the developed world from complications related to airway management and the scenario in the underdeveloped world is much grimmer.

AIM OF THE STUDY

To compare the intubating conditions with Airtraq laryngoscope and Macintosh laryngoscope in respect to

- Advantages and safety
- Effective intubation time
- Airway trauma

STRUCTURE AND FUNCTION OF THE UPPER AIRWAYS[4,5,6]

Anatomically airway is the passage through which air passes during respiration. It may be divided into the upper and lower airway. The upper airway comprises nasal cavity, oral cavity, nasopharynx, oropharynx, pharynx and larynx.

NASAL CAVITY:

Nasal cavity extends from nares to end of the turbinates. The normal airway begins functionally at the nares. As air passes through the nose, the important functions of warming and humidification occur. The nose is the primary pathway for normal breathing. The nasal cavities are divided by the nasal septum. The roof is formed by the cribriform plate of the ethmoid bone. The bony lateral wall is the origin of the three bony turbinates that project into the nasal cavity. Openings in the lateral wall communicate with paranasal sinuses.

ORAL CAVITY:

It extends from mouth opening to anterior tonsillar pillar. Contracture of mouth and lips can lead to difficulty in laryngoscopy. The roof of the mouth is bounded by alveolar arch and teeth and consists of the hard palate anteriorly and soft palate posteriorly. The tongue makes up most of the mouth, which is bounded by the mandible and teeth. The ability to achieve good mouth opening

is important for any airway procedure. Initial mouth opening is achieved by rotation within the temperomandibular joint and subsequent opening by sliding of the condyles of the mandible within the joint.

PHARYNX:

The pharynx is a fibromuscular tube that extends from the base of the skull to the lower border of cricoid cartilage. It joins the nasal and oral cavities above, with larynx and oesophagus below. It is divided into nasopharynx and oropharynx.

THE NASOPHARYNX:

Extends from the posterior end of the turbinates to posterior pharyngeal wall above the soft palate and consists of the nasal cavity, septum, turbinates and adenoids.

THE OROPHARYNX:

Extends from the soft palate above to the epiglottis below, and anteriorly from the tonsillar pillar to the posterior pharyngeal wall. It includes the tonsils, uvula and the epiglottis. The tongue is the principal source of oropharyngeal obstruction, usually because of decreased tone of the genioglossus muscle. The latter contracts to move the tongue forward during inspiration and thus acts as a pharyngeal dilator. The vallecula is the space between epiglottis and base of the tongue. It has paired depressions on both sides of glosso epiglottic fold.

Laryngoscope blade tip is positioned in vallecula during conventional laryngoscopy. Gentle upward pressure on the vallecula with laryngoscope blade tensions hyuepiglottic ligament and indirectly elevates the larynx and helps in the alignment of laryngeal and pharyngeal axes.

LARYNX:

The larynx, which lies at the level of the third through sixth cervical vertebrae, serves as the organ of phonation and as a valve to protect the lower airways from the contents of the alimentary tract.

The laryngeal cavity extends from the epiglottis to the lower level of the cricoid cartilage. The larynx bulges posteriorly into the laryngopharynx, with the pyriform fossa lying on each side. It is suspended from the hyoid bone by the thyrohyoid membrane.

The structure consists of muscles, ligaments, and a framework of cartilages. These include the thyroid, cricoids, arytenoids, corniculates and the epiglottis. The latter, a fibrous cartilage, has a mucous membrane covering that reflects as the glossoepiglottic fold onto the pharyngeal surface of the tongue. The epiglottis projects into the pharynx and overhangs the laryngeal inlet. However, it is not absolutely essential for sealing off the airway during swallowing.

The inlet is formed by the epiglottis, which joins to the apex of the arytenoids cartilages on each side by the aryepiglottic folds. Inside the laryngeal cavity one first encounters the vestibular folds, which are narrow bands of fibrous tissue on each side. These extend from the anterolateral surface of each arytenoids to the angle of the thyroid where the latter attaches to the epiglottis. These folds are referred to as the false vocal cords and are separated from the true vocal cords by the laryngeal sinus or ventricle.

The true vocal cords are pale white ligamentous structures that attach to the angles of th thyroid anteriorly and to the arytenoids posteriorly. The triangular fissure between these vocal cords is termed the glottic opening, which represents the narrowest segment of the laryngeal opening in adults.

Cricoid cartilage is a complete ring shaped cartilage and continues with trachea. In young children(<10 years old), the narrowest segment lies just below the cords at the level of the cricoid ring.

The mean length of the relaxed open glottis is 23 mm in males & 17 mm in females.

Conventional laryngoscopy is performed in the supine position. In this position oral, pharyngeal and laryngeal axes of the patient are offset, making it difficult to obtain a good view of glottis by the conventional laryngoscope. A slight neck flexion of $25^0 – 35^0$ and head extension of approximately 85^0 at

atlanto occipital joint helps to align the axes called Magill's (sniffing) position[7].

As successful direct laryngoscopy and intubation requires the alignment of oral, pharyngeal and laryngeal axes, the intubation and visual confirmation are often complicated by the anatomical abnormalities of the upper airway, comorbid illness, position of the patient as well as by the location and other external factors.

In recent decades, video techniques using fibreoptic technology and Airtraq laryngoscopes based on reflecting mirrors are being commonly employed. They have rigid curved blades to match the anatomical alignment[8] thus improving laryngeal view even in patients who can't be kept in ideal sniffing position.

OVERVIEW OF LARYNGOSCOPE DESIGN[9]:

Commonly used laryngoscopes can be classified as

CONVENTIONAL LIGHT LARYNGOSCOPES: The light source is at the distal end of the blade, powered by batteries at the handle and electrical connections to illuminate the lamp.

Examples include:

- Macintosh type laryngoscopes (curved blades)
- Miller type laryngoscopes and other straight blade designs
- McCoy laryngoscope and variants (articulating tip)

FIBREOPTIC LIGHT LARYNGOSCOPES[10]: Advancement in newer lighting technologies eliminated electric wire, lamps and contacts from blade thus producing a very dependable, cold and brighter illumination. Now LED/ XENON lamps that produce excellent light, which follows a quartz glass fibre optic bundle or plastic bundle along the blade to illuminate a patient's oral cavity are used.

Laryngoscopes using fibreoptic principle include:

- Rigid fibreoptic Laryngoscopes
    1. Bullard laryngoscope
    2. Upsher laryngoscope
    3. Wu laryngoscope (Wuscope)
- Video laryngoscope (with microminiature TV camera)
- Flexible Fibreoptic laryngoscope (Bronchoscopes)

INDIRECT LARYNGOSCOPES: Here the image is transmitted from the illuminated tip to the view finder via a series of lenses, prisms and mirrors. A high-quality, wide-angle view of the glottis and surrounding structures and the tip of the endotracheal tube is provided.

Example : the Airtraq laryngoscope.

HISTORY OF LARYNGOSCOPES[11]

The history of the laryngoscope can be traced to the middle of the eighteenth century; it is only since the early decades of the twentieth century that visualization of the vocal cords has been important in anaesthesia.

- Vesalius in 1543 reported the first tracheal intubation in an animal.
- First laryngoscope was invented in 1854 by Manuel Patricio Rodriguez Garcia.

- In the early 1870s, Trendelenburg from Germany performed the first endotracheal anaesthesia in man.
- In 1913 the first anaesthetic laryngoscope was invented by Jackson.
- Modern day laryngoscope systems began in early 1940s.
- In 1942, Curare was introduced as a muscle relaxant for abdominal relaxation during general anaesthesia and endotracheal intubation became routine in major abdominal and other surgeries.
- In 1941, Robert Miller designed a blade with a curve on the bottom and a curved distal tip, which is now known as the Miller blade.
- Robert Macintosh designed a blade with a conyinous curvature in 1943. The added curve was designed to lessen the chance of damage to the patient's upper teeth.
- Modifications over the years have been made to both the blades for the purpose of providing more optimal intubating conditions.
- The Airtraq laryngoscope was invented by Dr.Pedro Acha and manufactured by Prodol Meditec, Vizcaya, Spain and was first presented to the market in 2006.

DESCRIPTION OF MACINTOSH LARYNGOSCOPE[12]:

Macintosh laryngoscope consists of a handle and detachable blade. The light source is energized when the blade and handle are locked in the working position.

HANDLE:

The handle provides the power source for light. A hook on hinge folding connection between the handle and the blade is most commonly used. The handle is fitted with a hinge pin that fits a slot on the base of the blade. This allows quick and easy attachment and detachment. Handles have a metallic contact, which completes an electrical circuit when handle and blade are in working position.

BLADE:

The blade is the rigid component that is inserted into the mouth. The blade is composed of a base, heel, tongue, flange, web, tip and light source. The tongue or spatula is the main shaft. It has smooth, gentle curve that extends to the tip. It serves to compress and manipulate the soft tissues especially the tongue and lower jaw. The flange projects off the side of the tongue and is connected to it by the web. It serves to guide instrumentation and deflect tissues out of the line of vision. The flange determines the cross sectional shape. In Macintosh blade the cross sections form a reverse Z. The tip or beak contacts vallecula and helps to elevate the epiglottis. It is usually

blunt to decrease trauma. In Macintosh blade, bulb or fiberoptic light source can be connected.

INTUBATION WITH MACINTOSH LARYNGOSCOPE[13]:

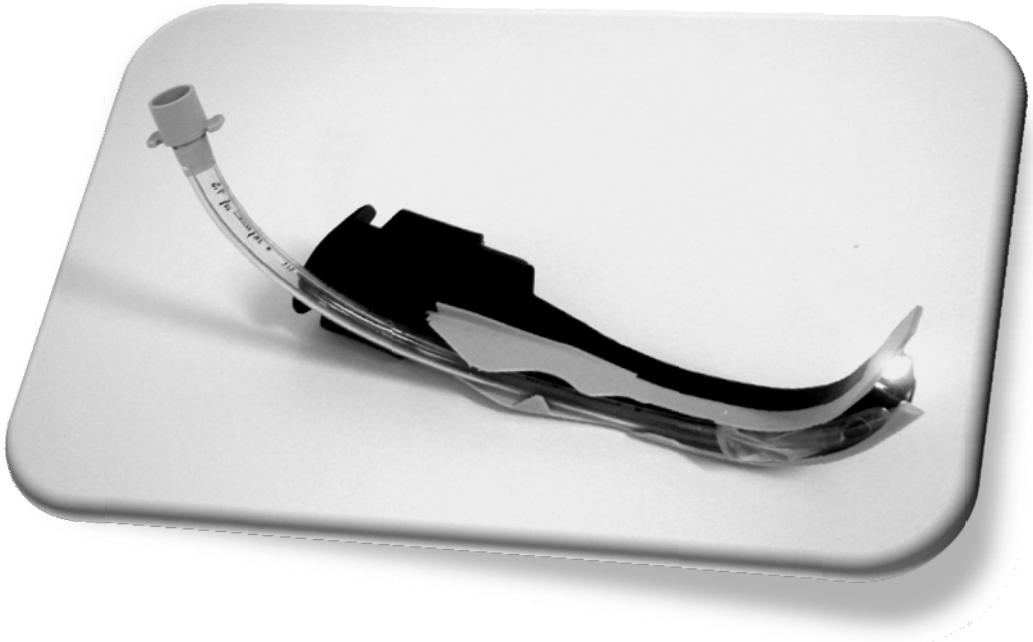
Proper preparation should include airway assessment, assembling and checking airway equipment and finally achieving sniffing position. Positioning the height of the table at the level of laryngoscopist's naval helps to achieve a straight line between the operator's eye and the patient's upper airway.

The Macintosh blade should be held with the left hand while the right thumb and index finger open the mouth. Laryngoscope blade should be introduced from the right side of the patient's mouth without engaging the lips and teeth. When half of the blade is introduced tongue should be swept to the left as laryngoscope blade is moved to the centre.

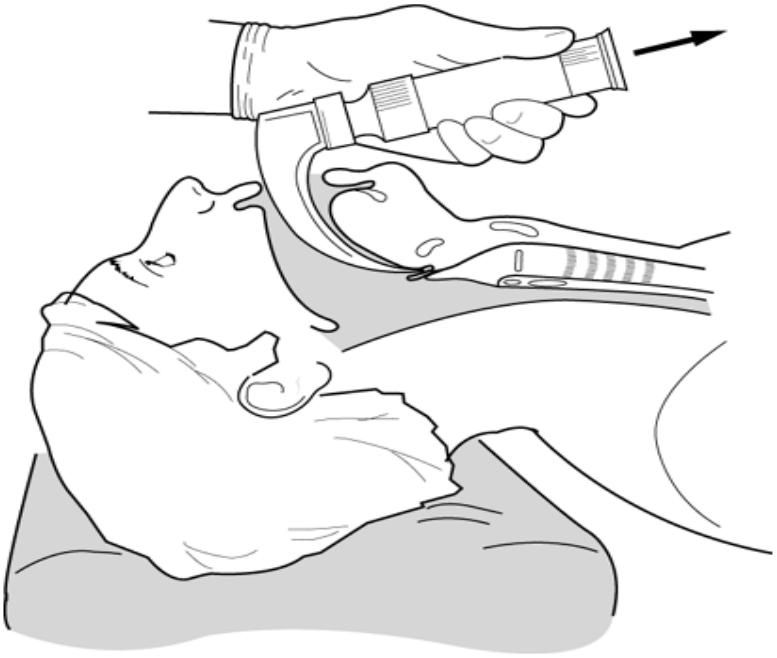
On deeper entry into the oral cavity, the blade tip is positioned between the base of the tongue and the pharyngeal surface of the epiglottis (vallecula). At that stage th tongue and pharyngeal soft tissues are lifted to expose the glottis opening.

MACINTOSH LARYNGOSCOPE

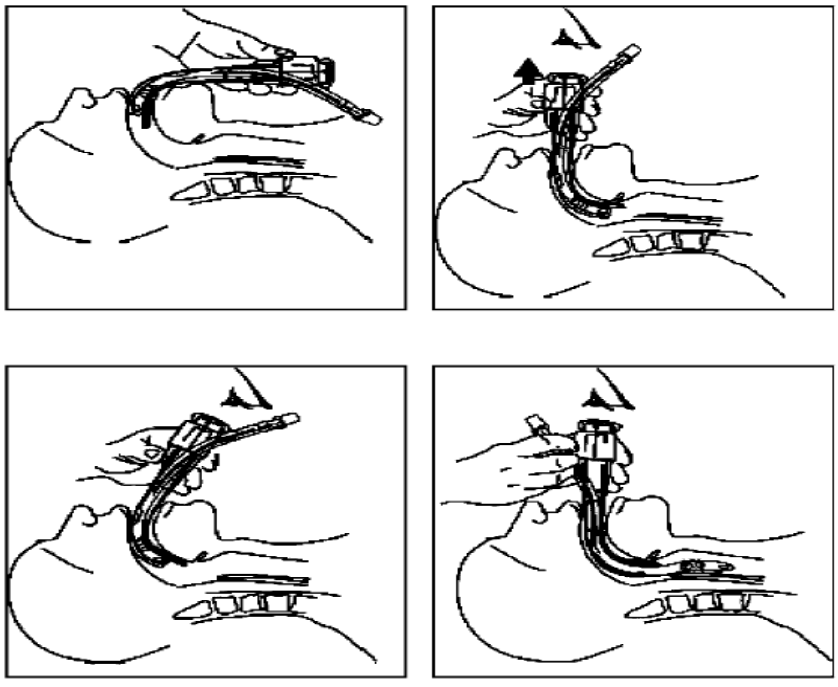
AIRTRAQ LARYNGOSCOPE



INTUBATION WITH MACINTOSH LARYNGOSCOPE



INTUBATION WITH AIRTRAQ LARYNGOSCOPE



DESCRIPTION OF AIRTRAQ LARYNGOSCOPE[14]:

The design of Airtraq laryngoscope is such as to provide a view of the glottis without alignment of the oral, pharyngeal and tracheal axes.The device is made of medical grade plastic material. The blade of the Airtraq consists of two side by side channels. One channel acts as the housing for the placement and insertion of the tracheal tube, and the other channel terminates in a distal lens. A battery operated light is present at the tip of the blade. The maximum thickness of the blade is 18 mm.The image is transmitted to a proximal viewfinder using a combination of lenses and prisms, rather than fibreoptics. The viewing lens allows visualization of the glottis and surrounding structures and the tip of the tracheal tube.

The Airtraq is anatomically shaped and standard tracheal tubes of all sizes can be used. A clip-on wireless video system[15] is also available which allows viewing on an external screen. This may be particularly useful for teaching purposes.

USE OF AIRTRAQ LARYNGOSCOPE:

To use the Airtraq device, it is activated 30 seconds before use by pressing the button located on the left side of the viewfinder which turns on the light and warms up the distal optical system to prevent fogging; the light stops blinking when the antifogging mechanism is fully activated. The selected

AIRTRAQ – DEVICE DESCRIPTION

tracheal tube is then placed into the tube – guide channel aligning the tip of the tube with the distal optical system.

The Airtraq is inserted in the midline into the oral cavity. The blade is then slid around the tongue into the posterior pharynx; optimum depth of insertion is determined by the vallecula. Before the Airtraq's main body reached the vertical plane, visualization of laryngeal structures is attempted. The blade is occasionally slightly elevated against the dorsal face of the tongue with minimum upward pressure for indirectly lifting the epiglottis.

With the laryngeal aperture in the center of the view-finder , the tracheal tube is gently advanced from the position in the tube-guide channel through the laryngeal aperture. In case of difficulty in insertion, the blade is slightly withdrawn, elevated, and/or rotated to the right or left side and tracheal tube insertion is repeated and is inserted ino a midtracheal position. After visual confirmation of correct placement, the tracheal tube is secured at its proximal end and disengaged from the tube-guide channel and the Airtraq is removed by rotating the unit forward back and gently lifting it out of the oral cavity.

REVIEW OF LITERATURE

The literature was searched and reviewed to seek for advantages and the problems related to Airtraq aided intubation techniques.

1. Chrisen H. Maharaj , Elma Buckley, Brian.H.Harte and John.G.Laffey, Department of Anaesthesia, University College Hospital, Galway, Ireland, conducted study on "Endotracheal intubation in patients with cervical spine immobilization- A comparison of Macintosh and Airtraq laryngoscopes"[16] in 40 patients and found that the Airtraq reduced the duration of intubation (mean 13.2 seconds vs 20.3 seconds with Macintosh), the need for additional maneuvers, and the intubation difficulty scale score(0.1 vs 2.7). Tracheal intubation with the Airtraq caused fewer alterations in blood pressure and heart rate.
2. Yoshihiro Hirabayashi and Norimasa Seo, Department of Anaesthesiology, Jichi Medical University, Tochigi, Japan conducted a study on 20 patients where nasotracheal intubation was performed by a non-anaesthesia physician with 1-2 months of training in airway management and compared the intubating conditions between Macintosh and Airtraq laryngoscopes[17]. It was found from the study that nasotracheal intubation was achieved in 65 seconds (mean) using Airtraq laryngoscopy, while it required a significantly longer time of 123 seconds (mean) using Macintosh laryngoscopy with Magill forceps. No patient in the Airtraq group experienced esophageal intubation,

while one resident performed an esophageal intubation in the Macintosh group. It was concluded from the study that in comparison with the Macintosh laryngoscope, the Airtraq laryngoscope provides superior intubation conditions for personnel who are training in airway management, resulting in less time to secure the airway.

3. S.K.Ndoko, R.Amathieu, L.Tual, C.Polliand, W.Kamoun and L.El.Housseini, Anasthesia and Intensive Care department, Jean Verdler Public University Hospital, Paris, France, conducted a study on "Tracheal intubation of morbidly obese patients: a randomized trial comparing performance of Macintosh and Airtraq laryngoscopes"[18] in 106 morbidly obese patients undergoing surgery and found that in the Airtraq group, tracheal intubation was successfully carried out in all the patients within 120 seconds and in the Macintosh group, six patients required intubation with the Airtraq laryngoscope. The mean time taken for tracheal intubation was 24 seconds and 56 seconds respectively with the Airtraq and Macintosh laryngoscopes. SpO2 was better maintained in the Airtraq group than in the Macintosh laryngoscope group with one and nine patients, respectively, demonstrating drops of SpO2 to 92% or less. They concluded from the study that the Airtraq laryngoscope shortened the duration of tracheal intubation and prevented reductions in arterial oxygen saturation in morbidly obese patients.

4. Schirin M.Missaghi, Klaus Kraser, Hildgard Lackner, Anita Moser and Ernst Zadrobilek, Department of Anaesthesia and Intensive Care, Empress Elisabeth

Hospital of the city of Vienna, Austria conducted a study " The Airtraq Optical Laryngoscope: Experiences with a new disposable device for orotracheal intubation." [19]214 patients undergoing elective thyroid surgery were investigated. Patients with previously experienced difficult conventional tracheal intubation, anatomic features predictive for difficult conventional laryngoscopy and tracheal intubation and/or obesity were given preferential enrollment. Cormack Lehane View was performed with a Macintosh laryngoscope. The laryngeal views obtained with the Airtraq were evaluated and the tracheal tube was placed and advanced through the laryngeal aperture. Grades 1 to 5 at Cormack Lehane View were obtained in 74,62,44, 32, and 2 patients respectively in conventional laryngoscopy. The success rate of Airtraq assisted tracheal intubation at the first attempt was 97%(207/214) with laryngeal views of grade 1 in all of these patients. Minor problems and difficulties with impeded blade insertion and impeded tracheal tube insertion were encountered in 9 and 12 percent respectively. 7 patients required a second attempt for tracheal intubation; the causes were failed identification of anatomical structures(1 patient), failed tracheal tube advancement during laryngeal passage(4 patients), and requirement of downsizing the tracheal tube for unimpeded and atraumatic laryngeal passage(2 patients). In all patients, Airtraq assisted tracheal intubation was successful(after a maximum of 2 attempts). They concluded from the study that provided formal instruction, success of tracheal intubation with Airtraq performed by novice users was not

affected by Cormack Lehane View. The Airtraq proved to be uniquely useful for routine and difficult laryngoscopy and tracheal intubation.

5. A study titled " Evaluation of intubation using the Airtraq or Macintosh laryngoscope by anaesthetists in easy and simulated difficult laryngoscopy- a manikin study" [20]was conducted by C.H.Maharaj, B.D.Higgins, B.H.Harte, and J.G.Laffey, Department of Anaesthesia, University College Hospital,Galway, Ireland in which the Airtraq and Macintosh laryngoscope were compared in simulated easy and difficult laryngoscopy. 25 anaesthetists were allowed up to 3 attempts to intubate the trachea in each of three laryngoscopy scenarios using a Laerdal® Intubation Trainer followed by 5 scenarios using a Laerdal SimMan® Manikin. Each anaesthetist then performed tracheal intubation of the normal airway a second time to characterise the learning curve. In the simulated easy laryngoscopy scenarios, there was no difference between the Airtraq and Macintosh in success of tracheal intubation. The time taken to intubate at the end of the protocol was significantly lower using the Airtraq(9.5 secs vs 14.2 secs), demonstrating a rapid acquisition of skills. In the simulated difficult laryngoscopy scenarios, the Airtraq was more successful in achieving tracheal intubation, required less time to intubate successfully, caused less dental trauma, and was considered by the anaesthetists to be easier to use.
6. Zadrobilek.E. et al conducted a study titled " Success of orotracheal intubation with the Airtraq optical laryngoscope in patients with difficult conventional

laryngoscopy"[21] on 312 patients for elective thyroid surgical procedures with various conventional laryngoscopic views. Further 20 patients with difficult conventional laryngoscopy (CL) also for elective thyroid surgery attempted by using the Airtraq were additionally included in this clinical review. In the 332 patients evaluated, grade 1 to 5 at CL was obtained in 111,90,61,68 and 2 patients respectively. The overall success rate of Airtraq assisted tracheal intubation at the first attempt was 98%; in all patients, tracheal intubation was successful after a maximum of 2 attempts. In the 70 patients with difficult CL (grade 4 or 5), the success rate of Airtraq assisted tracheal intubation at the first attempt was 94% (66/70 patients). The causes of primary failures of tracheal intubation were failed identification of anatomical structures (in one patient) and failed tracheal tube advancement during laryngeal passage (in 3 patients). Visualization of the entire laryngeal aperture was finally obtained in all patients; downsized tracheal tubes for atraumatic tracheal intubation were required in 2 patients.

7. A study titled " The Airtraq laryngoscope for placement of double-lumen endobronchial tube"[22] was conducted by Y.Hirabayashi and N.Seo, Jichi Medical University, Japan to study the usefulness of Airtraq in the placement of double-lumen tubes. They found that the Airtraq laryngoscope allowed placement of 35 and 37 French double lumen tubes in 10 patients without complications. A regular size Airtraq laryngoscope accepts 35 and 37 French double lumen tubes, although the latter was somewhat thick against the

channel of the scope. It is probably impossible to insert a 39 French double lumen tube with an outer diameter of 13 mm. They concluded that despite this limitation, the Airtraq laryngoscope appears to be an alternative approach dor double lumen tube placement when the physician encounters cases in which the conventional Macintosh laryngoscopy results in unsuccessful double lumen tube placement.

8. A study titled "Comparison of the Airtraq® and Truview® laryngoscopes to the Macintosh laryngoscope for use by Advanced Paramedics in easy and simulated difficult intubation in manikins " [23]was performed by Sajid Nasim, Chrisen H Maharaj, Ihsan Butt, Muhammad A Malik, John O' Donnell, Brendan D Higgins, Brian H Harte and John G Laffey, Department of Anaesthesia, Galway University Hospitals, Galway, Ireland in which they compared the efficacy of these two devices to the Macintosh laryngoscope when used by 21 paramedics proficient in direct laryngoscopy in a randomized, controlled, manikin study. Each participant took turns performing laryngoscopy and intubation with each device, in an easy intubation scenario and following placement of a hard cervical collar, in a SimMan® manikin. They found that the Airtraq reduced the number of optimization maneuvers and reduced the potential for dental trauma when compared to the Macintosh, in both the normal and simulated difficult intubation scenarios. In contrast, the Truview increased the duration of intubation attempts and required a greater

number of optimization maneuvers, compared to both the Macintosh and Airtraq laryngoscope devices.

9. Lange.M., Frommer.M., and Redel.A conducted a study titled "Comparison of the Glidescope and Airtraq optical laryngoscopes in patients undergoing direct microlaryngoscopy."[24]

   In this study, the Airtraq and the Glidescope were compared in 60 ASA I-III patients with tumours of the upper airway undergoing direct endoscopic microlaryngoscopy. Patients were randomly assigned to the Airtraq or the Glidescope group and the Cormack and Lehane grade was assessed by Macintosh laryngoscopy prior to tracheal intubation. There were no differences in tracheal intubation success rates or duration of intubation attempts between both devices. The Cormack and Lehane grade was improved in 77% and 82% of cases in the Airtraq and Glidescope group, respectively. Blood traces on the device and traumatic pharyngeal lesions were found more frequently in the Airtraq group. The Airtraq and Glidescope laryngoscopes are valuable tools for the management of patients with potentially difficult airways with the Glidescope appearing to be less traumatic.

10. Emily L.Brown and Ron M.Walls compared the Airway Scope , Airtraq and Macintosh in 4 simulated difficult airway scenarios, namely normal airway, cervical spine rigidity, limited mouth opening, and pharyngeal obstruction[25]. They concluded that the tracheal intubation success rate was significantly higher with the Airway Scope and Airtraq than with the

Macintosh laryngoscope(100% and 98% vs 89%). Mean time to intubation and mean time to first inflation of the lungs were significantly shorter with the Airway Scope than with either the Airtraq or Macintosh laryngoscopes (intubation, 10.6 vs 16.2 vs 15.8 seconds, respectively; inflation, 16.1 vs 21.6 vs 23.5 seconds respectively). In the limited mouth-opening scenario, rates of successful intubation were significantly higher with the Airway Scope and Airtraq than with the Macintosh laryngoscope (100% and 100% vs 83%). Successful intubation rates for other scenarios were not statistically significant.

11. Malin.E., Montblanc.J.de., Ynineb.Y., Marret.E., Bonnet**.**F conducted a case series on the "Performance of the Airtraq™ laryngoscope after failed conventional tracheal intubation" [26] .The Airtraq™ was used in 47 patients with predicted or unpredicted difficult intubation after failed orotracheal intubation performed by two senior anaesthesiologists with the Macintosh laryngoscope.

    Tracheal intubation with Airtraq™ was successful in 36 patients (80%). The Cormack and Lehane score was IIb-III in 35 patients, and IV in 12 patients, with the Macintosh laryngoscope, while Cormack and Lehane score was I-IIa in 40 patients, IIb-III in three and IV in four with Airtraq™. A gum elastic bougie was used to facilitate tracheal access in one-third (11/36) of the cases. Orotracheal intubation was not possible with Airtraq™ in nine cases, five of whom had a pharyngeal, laryngeal or basal lingual tumour. They concluded that **i**n patients with difficult airway, following failed conventional orotracheal

intubation, Airtraq™ allows securing the airway in 80% of cases mainly by improving glottis view. However, the Airtraq™ does not guarantee successful intubation in all instances, especially in case of laryngeal and/or pharyngeal obstruction.

12.Harald Groeben, Gregor Saint Mont, Roman Pförtner, Ilona Biesler, Anesthesiology & CCM, Clinics Essen-Mitte, Essen, Germany compared intubation using a modified Airtraq for nasal intubation and Standard Macintosh Blade in Difficult Nasal Intubation[27] . 80 patients scheduled for maxillo-facial surgery, requiring nasal endotracheal intubation, with an expected difficult intubation were enrolled for the study and were randomized for intubation with a Macintosh (n=40) or Airtraq laryngoscope (n=40). All patients had one or more risk factors for a difficult intubation (mouth opening ≤ 2.5 cm, Mallampati score of IV, documented history of difficult intubation, obvious tumor or swelling). Success rate, visualization of the glottis, time for intubation, and need for optimization maneuvers (cricoid pressure, change of head position, Eschmann stylet, Magill forceps) were evaluated. It was found that intubation with the Airtraq was successful in 37 out of 40 patients while conventional intubation was successful in 26 out of 40 patients. The visualization of the glottis according to Cormack & Lehane (22/14/1/3 vs. 4/11/11/14), time for intubation (50±61s vs. 91±50s) and the need for supporting maneuvers (0 to 4 maneuvers: Airtraq 19/10/5/4/0 vs. Macintosh

3/5/11/18/0) were significantly different in favor of the Airtraq technique. Overall, a Magill forceps was not used to advance the tube and could not even been brought close to the glottis in 52 patients.

It was concluded that Nasal Airtraq for difficult endotracheal intubations provided a significantly better view of the glottis with less need for optimizing maneuvers. Accordingly, the time for intubation was significantly shorter and the success rate was significantly higher with the Airtraq technique.

METHODOLOGY

It was a Prospective, Randomized, Single blinded (subject), Case control study conducted in the Institute of Anaesthesiology and Critical Care, Madras Medical College and Government General Hospital, Chennai. 60 adult patients satisfying inclusion criteria were enrolled in the study after obtaining informed consent.

INCLUSION CRITERIA

- Elective adult surgical patients requiring general endotracheal anaesthesia
- Males and females
- ASA physical status 1,2 & 3
- Age 18 years of age and older
- Who have given valid informed consent

EXCLUSION CRITERIA

- Healthy volunteers
- Not satisfying inclusion criteria
- Patients requiring special techniques for intubation such as rapid sequence induction

- Intubated prior to surgery
- Severe cardiovascular, hepatic or renal disease, mental illness
- Are unconscious or very severely ill, ASA physical status IV
- Need for nasal intubation

MATERIALS

- Macintosh laryngoscope- current standard device
- Airtraq laryngoscope device- used during laryngoscopy to facilitate intubation
- Weighing machine calibrated to 1 kg
- Measuring tape calibrated to 0.5 cm
- Goniometer

AIRWAY ASSESSMENT[28]

Previous anaesthesia records, H/O snoring, H/O voice change, H/O previous surgery, Trauma, Burns, Tumour in and around the oral cavity, neck or cervical spine were asked in the history.

H/O systemic illness like Diabetes, Hypertension, Ankylosing spondylitis, Rheumatoid arthritis were asked and recorded.

General examination included examination for facial anomalies, Temperomandibular joint pathology, Anomalies of the mouth and tongue, pathology of nose, pathology of palate.

Height in centimeters and weight in kilograms were recorded and Body Mass Index was calculated.

Individual airway indices were measured

A-O joint movement: Patient asked to look at the ceiling without raising the eyebrow and the range of movements were measured with gonioscope.

Neck flexion: Patient was asked to touch the manubrium sterni with chin and the range of movements measured with gonioscope.

TMJ function: The patient was asked to open his mouth wide open and the inter incisor distance measured. Examiner's index finger was placed in front of

the tragus and thumb over the mastoid process and the patient was asked to open the mouth and sliding movement of the mandibular condyle was assessed.

Upper lip bite test: The patient was asked to bite the upper lip with the lower incisor and graded as follows:

Class 1 : Lower incisor can bite the upper lip above the vermilion line.

Class 2 : Lower incisor can bite the upper lip below the vermilion line

Class 3 : Lower incisor cannot bite the upper lip

Thyromental distance: Distance between the thyoid notch and mental symphysis when the neck is fully extended and mouth closed.

Sternomental distance: Distance between the sterna notch and mental symphysis when the neck was fully extended and mouth closed.

Neck circumference: Measured in cm at the level of thyroid notch.

Examination of dentition: Abnormalities like cracking, buck tooth, loose, artificial and absence of incisors were examined and recorded.

Samson and Young modification of Mallampatti grading[29]:

The patient kept in sitting position with maximal mouth opening, protruding tongue, without phonation and the observer's eye in level with patient's mouth, the degree to which the faucial pillars, uvula, soft palate, and hard palate were visible were recorded and classified as follows:

Grade I : Faucial pillars, uvula, soft palate and hard palate visible

Grade II : Uvula, soft palate and hard palate visible

Grade III : Base of uvula or none, soft palate and hard palate visible

Grade IV : Only hard palate visible.

After assessment patient shifted to operating room.

i.v line started and monitors connected.

Patient allotted to either Airtraq or Macintosh group by way of sealed envelopes.

Airtraq and Macintosh laryngoscope checked for battery power.

Appropriate size endotracheal tube for the patient selected.

Heart rate, blood pressure and SpO2 measured (preinduction)

Inj. Glycopyrrolate 0.2mg and Inj. Fentanyl 2mcg/kg given as premedication.

Then preoxygenated with 100% oxygen at 6ltr/min for 3 min.

Induction done with Inj.Thiopentone 5mg/kg + NDP neuromuscular blocker.

Ventilated with face mask for 3 min.

Heart rate, blood pressure and SpO2 measured (preintubation).

Intubation attempted with Airtraq/Macintosh laryngoscope.

Observation of Cook's modification of Cormack and Lehane grading

Cook's modification of Cormack and Lehane grading and Intubation Difficulty Score were noted as follows:

CORMACK AND LEHANE GRADING SYSTEM[30]:

Entire vocal cord visualized - Grade I

Posterior part of vocal cords seen - Grade IIa

Arytenoids only seen - Grade IIb

Epiglottis only seen (liftable) - Grade IIIa

Tip of epiglottis only seen (adherent)- Grade IIIb

No glottis structure seen - Grade IV

INTUBATION DIFFICULTY SCORE :

Seven variables are used.

N1 - No: of supplementary attempts. An attempt is defined as one advancement of tracheal tube in the direction of the glottis during direct laryngoscopy.

N2 - No: of supplementary operators directly operating (not assisting)

N3 - No: of supplementary techniques used.

N4 - Cormack Lehane grade minus one.

N5 - Subjectively increased lifting force applied during larynoscopy.

N6 - Need for external laryngeal manipulation

N7 - Position of vocal cords. 0-abduction, 1-adduction.

If intubation with Airtraq failed and saturation maintained, Macintosh blade was used for intubation and if the saturation decreased, mask ventilation with 100% oxygen followed by intubation with Macintosh laryngoscope.

Apart from Cormack-Lehane and Intubation Difficulty Score, the following factors were also noted.

- Intubation time: Measured from entry of the device into the oral cavity until confirmation of proper placement of tracheal tube.
- Heart rate, blood pressure and SpO2 were measured 1,3 and 5 minutes post intubation.
- Complication rate: All complications will be recorded, with special attention to common complications such as upper airway and dental trauma.

OBSERVATION AND RESULTS

This prospective, randomized, single blind (subject), case controlled study compared the intubating conditions with Airtraq laryngoscope and Macintosh laryngoscope and evaluated the advantages and safety, effective airway time, airway trauma and hemodynamic response.

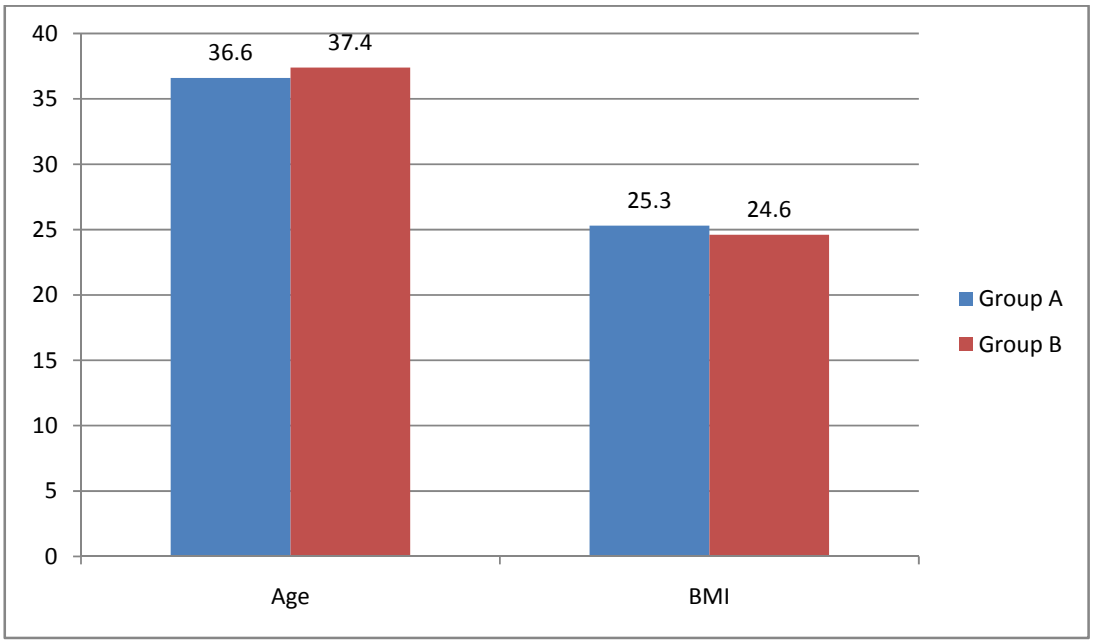
All data were collected and tabulated.

DEMOGRAPHIC VARIABLES:

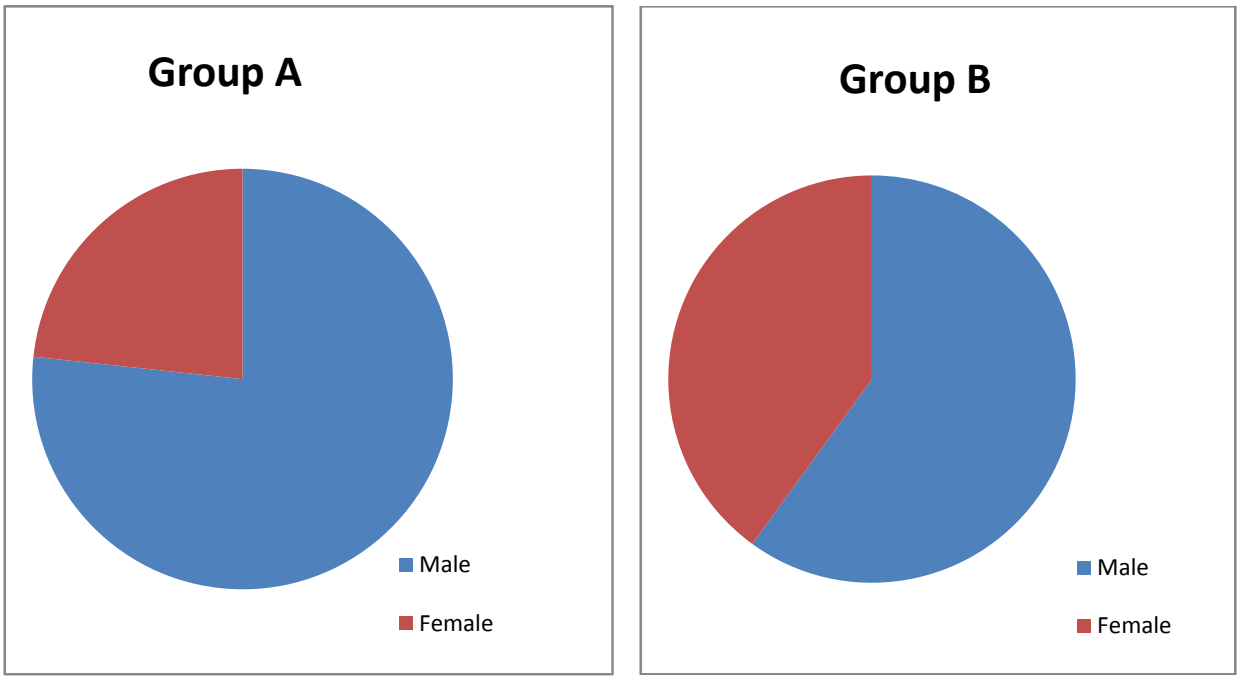
60 patients were randomly selected and included in this study. Thirty patients were randomly assigned to undergo tracheal intubation with Airtraq laryngoscope (group A) and thirty underwent tracheal intubation with Macintosh laryngoscope (group B). Mean age, sex distribution and Body Mass Index of the patients in both the group were compared and there were no statistically significant differences between the groups.

T Test:

PARAMETER ASSESSSED	Group A (AIRTRAQ)		Group B (MACINTOSH)		P value
	Mean	SD	Mean	SD	
Age, yr	36.63	13.91	37.4	12.82	0.825
Body Mass Index	25.302	4.375	24.66	3.3787	0.527



AGE and BMI Comparison between the two groups.



Sex distribution in both the groups

Chi – square Test:

Parameter assessed	Group A (AIRTRAQ)		Group B (MACINTOSH)		P value
	Male	Female	Male	Female	
Male, Female distribution	23 (76.7%)	7 (23.3%)	18 (60%)	12 (40%)	0.165

AIRWAY MEASUREMENTS:

The airways of both the group of patients were compared with respect to head extension, neck flexion, thyromental distance, inter incisor distance, neck circumference and Mallampatti classification and it was found that there was no statistically significant difference between the two groups.

- Patients in each group were divided on the basis of Head extension as to those with more than or equal to 85° and those with <85°.
- Patients were divided based on their neck flexion as to those with more than or equal to 25° and those with <25°.
- Based on thyromental distance the patients were divided into those with more than or equal to 6.5cm and those with <6.5cm.

- Based on inter incisor distance the patients were divided into those with more than or equal to 3 cm and those with <3cm.
- Neck circumference was measured using inch tape and the mean value of both the groups was compared using T test and were found to be statistically insignificant.
- 12 patients in Group A and 20 patients in Group B had a Mallampatti class 1. There were 17 patients in Group A and 10 patients in Group B with Mallampatti class 2. Only 1 patient in Group A had a Mallampatti class 3 and no patient in Group B had a MPC of 3. No patient selected in either of the group had a MPC of 4.

Chi – square Test:

Prameter assessed	Group A (AIRTRAQ)		Group B (MACINTOSH)		P value
Head extension	>85°	<85°	>85°	<85°	1
	28(93.3%)	2(6.7%)	28(93.3%)	2(6.7%)	
Neck flexion	>25°	<25°	>25°	<25°	1
	28(93.3%)	2(6.7%)	28(93.3%)	2(6.7%)	
Inter Incisor Distance	>3 cm	<3 cm	>3 cm	<3 cm	1
	29(96.7%)	1(3.3%)	29(96.7%)	1(3.3%)	
Thyro Mental Distance	>6.5cm	<6.5cm	>6.5cm	<6.5cm	1
	28(93.3%)	2(6.7%)	28(93.3%)	2(6.7%)	

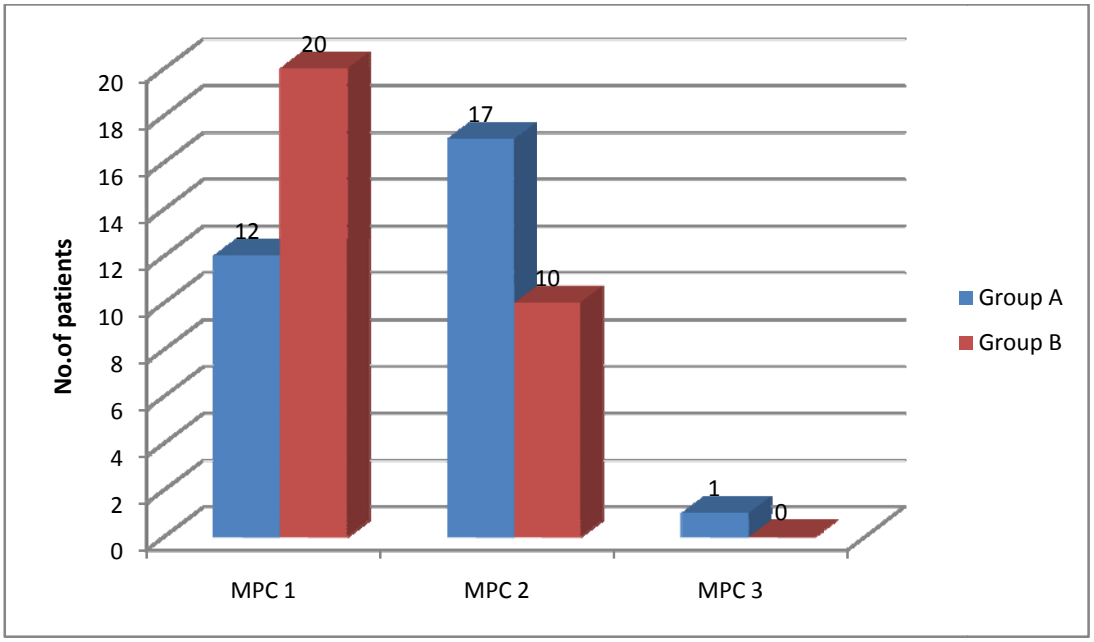
T Test:

Parameter assessed	Group	N	Mean (cm)	Std. deviation	P value
Neck circumference	A(Airtraq)	30	38.07	3.028	0.087
	B(Macintosh)	30	36.83	2.437	

MALLAMPATTI CLASS

Chi – square Test:

Mallampatti Classification	Group A (AIRTRAQ)	Group B (MACINTOSH)	P value
1	12 (40%)	20 (66.7%)	0.09
2	17 (56.7%)	10 (33.3%)	
3	1 (3.3%)	0 (0%)	
4	0 (0%)	0 (0%)	



MALLAMPATTI CLASS DISTRIBUTION ACROSS THE TWO GROUPS

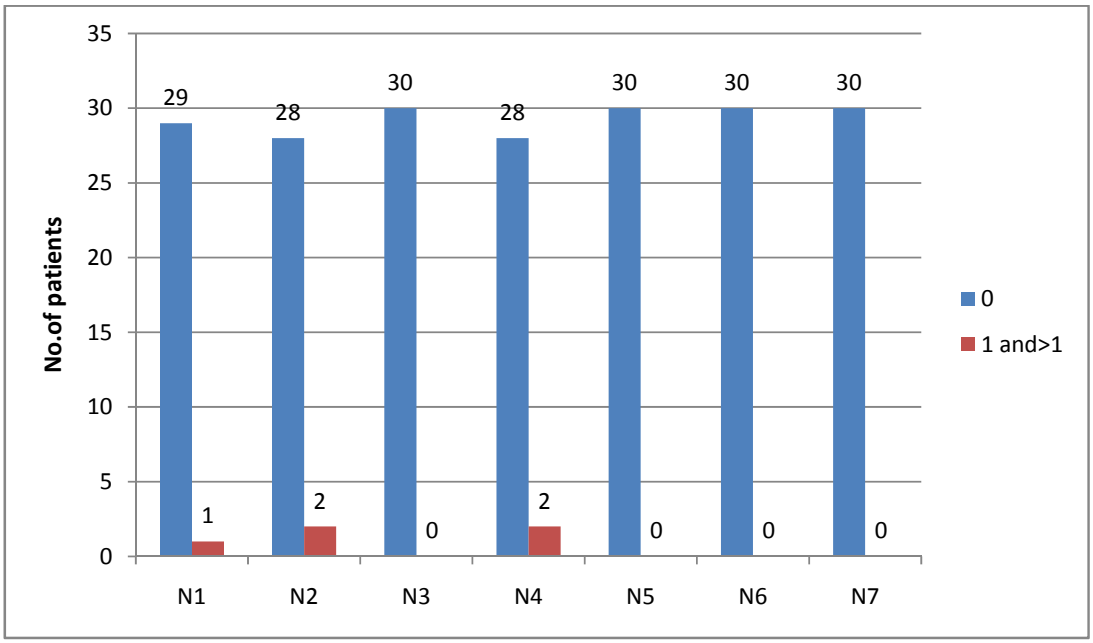
OUTCOME MEASURES:

INTUBATION DIFFICULTY SCORE (IDS)**:**

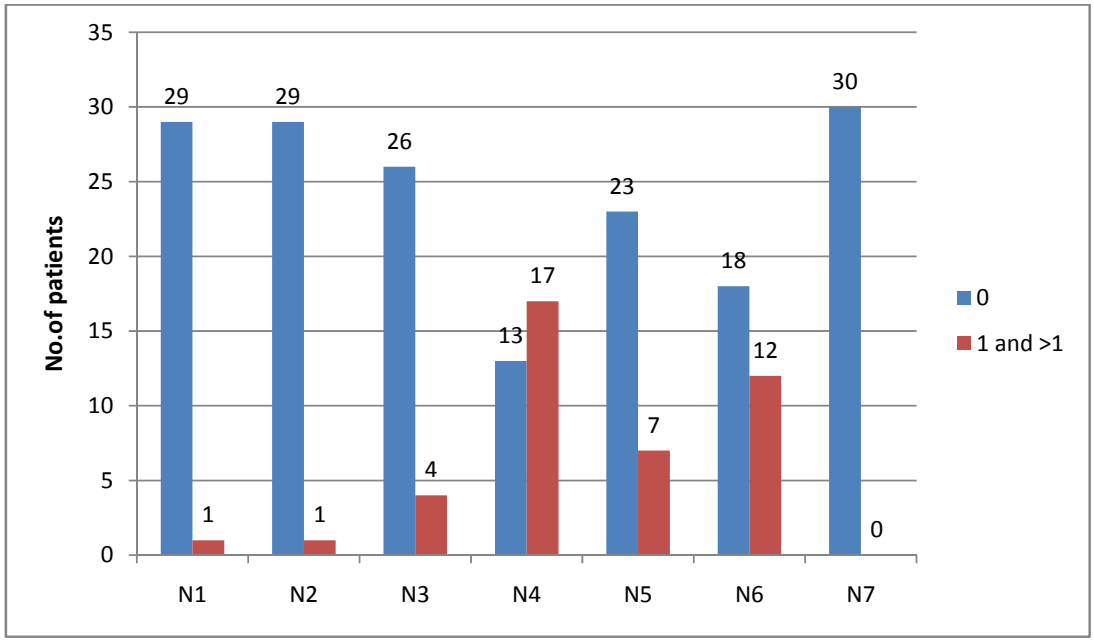
All patients in both the groups were intubated in the first attempt. 2 patients in the Airtraq group had an IDS of more than 1, whereas 17 patients in the Macintosh group had an IDS of 1 or greater. In the Macintosh group, 2 patients had an IDS of 5 or greater, indicating moderate to severe intubation difficulty whereas no patient in the Airtraq group had an IDS of more than 3. This was computed based on Levene's T test for equality of variances and the result was found to be statistically very significant with a P value of <0.0001.

Levene's T test:

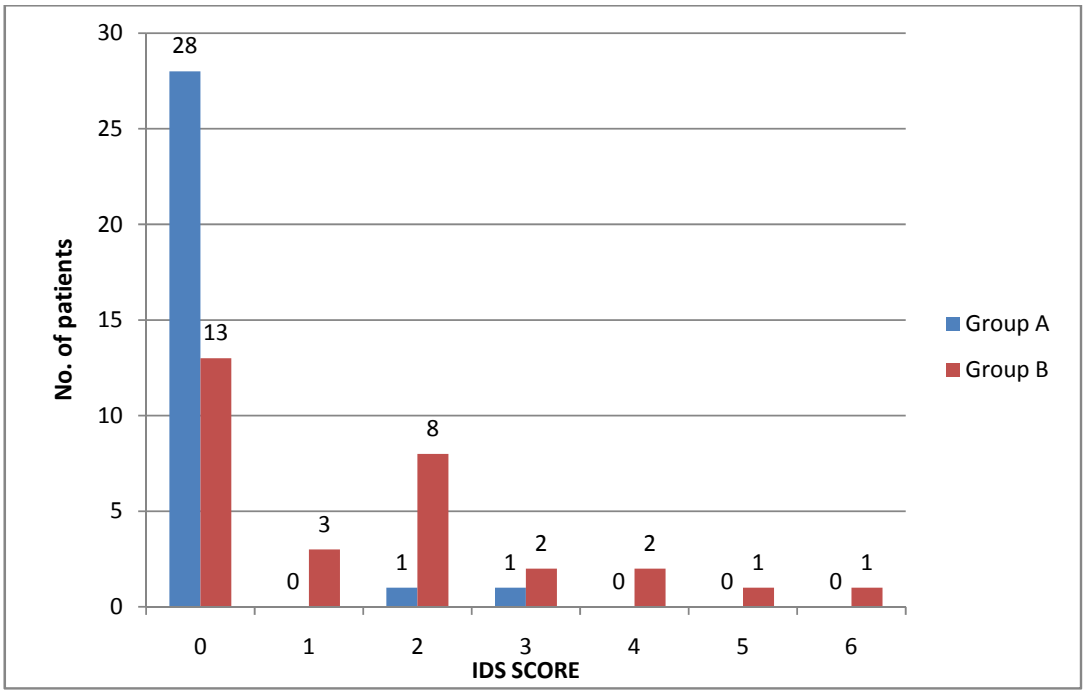
Group	Intubation Difficulty Score							Mean	Std Deviation	P value
	0	1	2	3	4	5	6			
A	28	0	1	1	0	0	0	0.17	0.648	<0.0001
B	13	3	8	2	2	1	1	1.47	1.676	



IDS Score for Airtraq group



IDS Score for Macintosh group



Total IDS score for both the groups

Comparison of intubation difficulty scale score distributions with the Airtraq versus Macintosh laryngoscopes. Number of patients is shown above each bar. P<0.0001 between groups, Mann-Whitney U test.

CORMACK and LEHANE grading:

Cormack and Lehane grade of both the group of patients were compared to grade the laryngeal view.

93.33% of patients in the Airtraq group had a CL grade of 1, compared to 43.33% of patients in the Macintosh group.

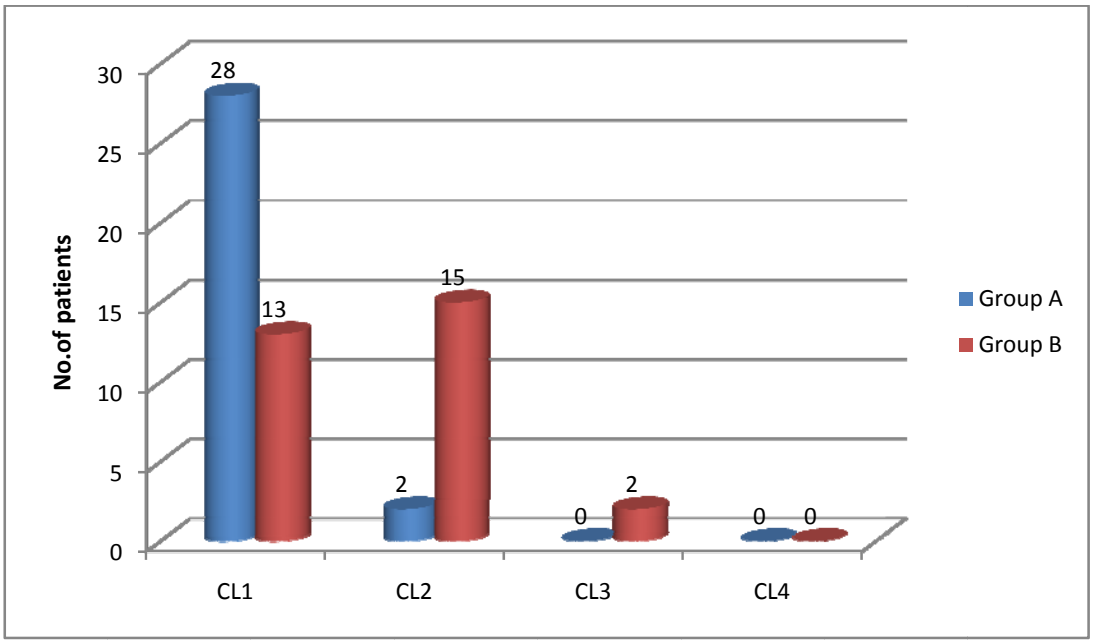
In the Airtraq group 6.67% of patients had a CL grade of 2 compared to 50% of patients in the Macintosh group.

No patient in the Airtraq group had a CL grade of 3 or 4, whereas 6.67% in the Macintosh group had a CL grade of 3 and none with a grade of 4.

The differences between the two groups were statistically significant.

Pearson Chi - square test:

Group	CL 1	CL2	CL3	CL4	P value
Airtraq	28(93.33%)	2(6.67%)	0(0%)	0(0%)	<0.0001
Macintosh	13(43.33%)	15(50%)	2(6.67%)	0(0%)	



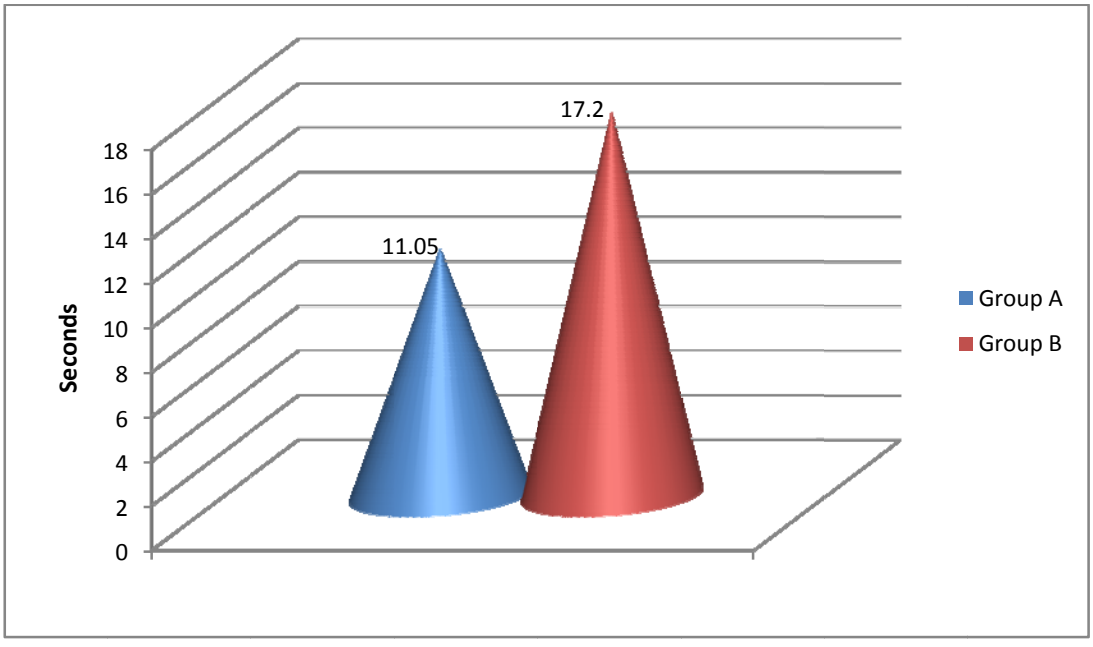
Cormack and Lehane grade distribution in both groups

DURATION OF INTUBATION:

Mean duration of intubation with the Airtraq group was 11.03 secs in the Macintosh group it was found to be 17.2 secs. It was computed using Levene's T test and was found to be statistically significant.

Levene's T test:

Parameter assessed	Group	N	Mean	S.D	P value
Duration	Airtraq	30	11.03	6.071	<0.0001
	Macintosh	30	17.2	5.047	



Duration of intubation in both the groups

HEMODYNAMIC CHANGES: The heart rate, blood pressure and spO2 of the patients were measured before induction, 30 secs before intubation and 1min, 3min and 5min post intubation and the values were computed by Chi – square test and it was found that the tracheal intubation with Macintosh laryngoscope resulted in a significant increase in heart rate, systolic, diastolic and MAP, compared with preintubation values, in contrast to the Airtraq.

PREINDUCTION (T test):

Parameters	Group	N	Mean	SD	P value
Heart rate	Group A	30	83.03	12.944	0.144
	Group B	30	88.73	16.613	
Systolic BP	Group A	30	120.50	15.431	0.126
	Group B	30	127.20	17.878	
Diastolic BP	Group A	30	79.20	9.792	0.188
	Group B	30	83.13	12.889	
MAP	Group A	30	93.00	11.277	0.166
	Group B	30	97.63	14.129	
SpO2	Group A	30	100.00	0	-
	Group B	30	100.00	0	

P value cannot be calculated for SpO2 as the SD for both the groups is 0.

PREINTUBATION

T test:

Parameters	Group	N	Mean	SD	P value
Heart rate	Group A	30	86.87	10.734	0.556
	Group B	30	88.83	14.697	
Systolic BP	Group A	30	111.50	15.136	0.405
	Group B	30	115.13	18.256	
Diastolic BP	Group A	30	74.17	11.618	0.921
	Group B	30	73.87	11.578	
MAP	Group A	30	86.57	12.227	0.749
	Group B	30	87.63	13.479	
SpO2	Group A	30	100.00	0	-
	Group B	30	100.00	0	

P value for SpO2 cannot be calculated as the SD of both the groups is 0.

1 min Post intubation

T test

Parameters	Group	N	Mean	SD	P value
Heart rate	Group A	30	102.07	17.648	0.001
	Group B	30	116.43	14.115	
Systolic BP	Group A	30	129.00	18.118	<0.0001
	Group B	30	150.80	18.430	
Diastolic BP	Group A	30	88.67	11.842	0.001
	Group B	30	100.50	13.354	
MAP	Group A	30	102.03	13.520	<0.0001
	Group B	30	117.30	14.707	
SpO2	Group A	30	99.90	.548	0.561
	Group B	30	99.80	.761	

3 min Post intubation

T test

Parameters	Group	N	Mean	SD	P value
Heart rate	Group A	30	92.30	14.003	0.004
	Group B	30	103.40	14.483	
Systolic BP	Group A	30	120.43	16.913	0.006
	Group B	30	133.57	18.578	
Diastolic BP	Group A	30	80.83	11.546	0.018
	Group B	30	88.43	12.506	
MAP	Group A	30	94.07	12.881	0.008
	Group B	30	103.60	14.036	
SpO2	Group A	30	100.00	.000	0.321
	Group B	30	99.97	.183	

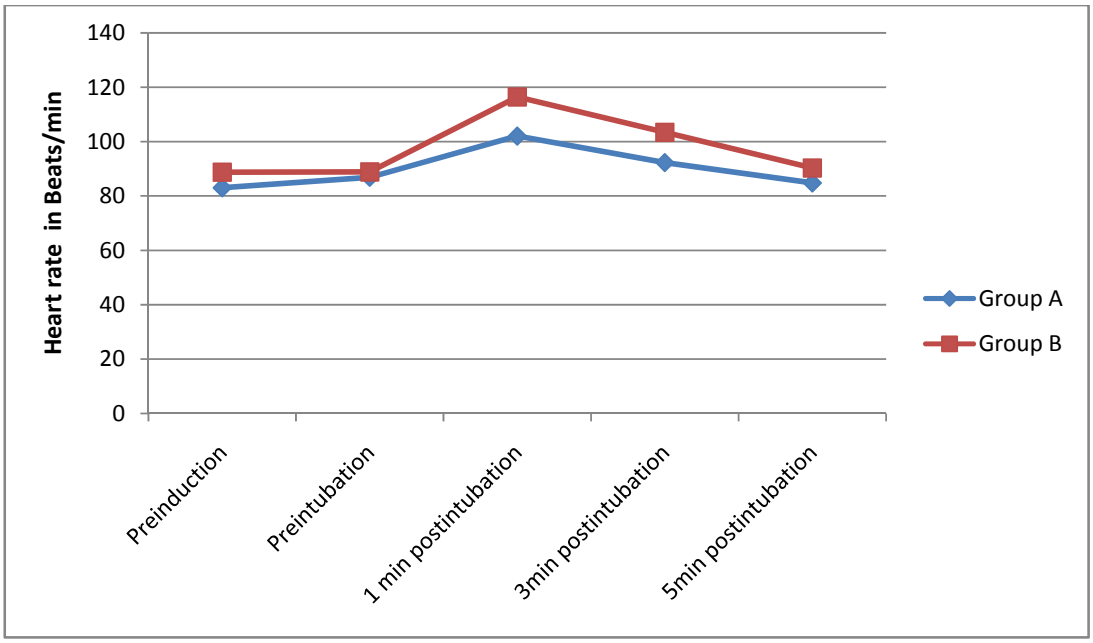
5 min Post intubation

T test

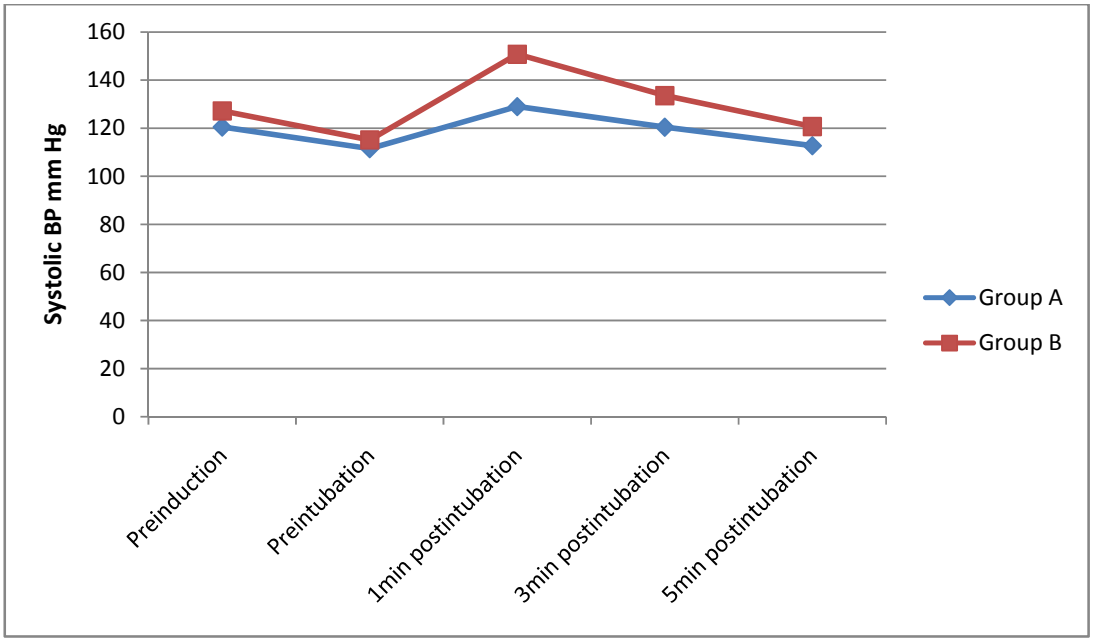
Parameters	Group	N	Mean	SD	P value
Heart rate	Group A	30	84.80	10.506	0.089
	Group B	30	90.30	13.899	
Systolic BP	Group A	30	112.73	12.188	0.033
	Group B	30	120.70	15.825	
Diastolic BP	Group A	30	75.07	10.123	0.435
	Group B	30	77.20	10.867	
MAP	Group A	30	87.53	10.644	0.167
	Group B	30	91.70	12.349	
SpO2	Group A	30	100.00	0	-
	Group B	30	100.00	0	

P value cannot be calculated for SpO2 as the SD for both the groups is 0 .

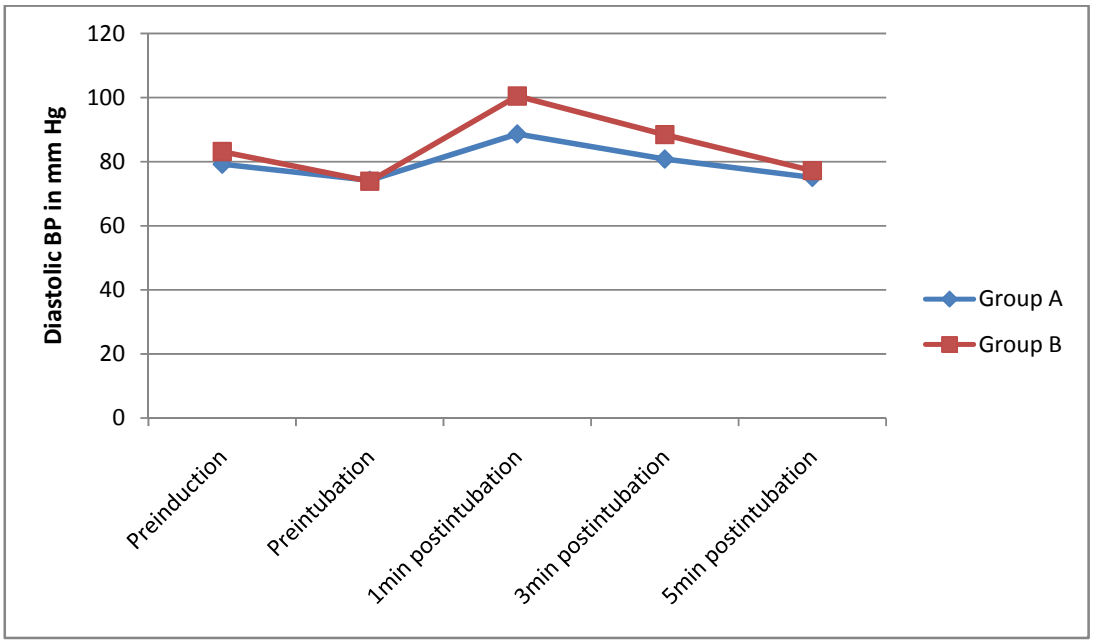
The differences in heart rate, and blood pressure in both the groups was statistically significant in the 1min and 3 min post intubation measurements and not significant in the 5 min post intubation measurement.



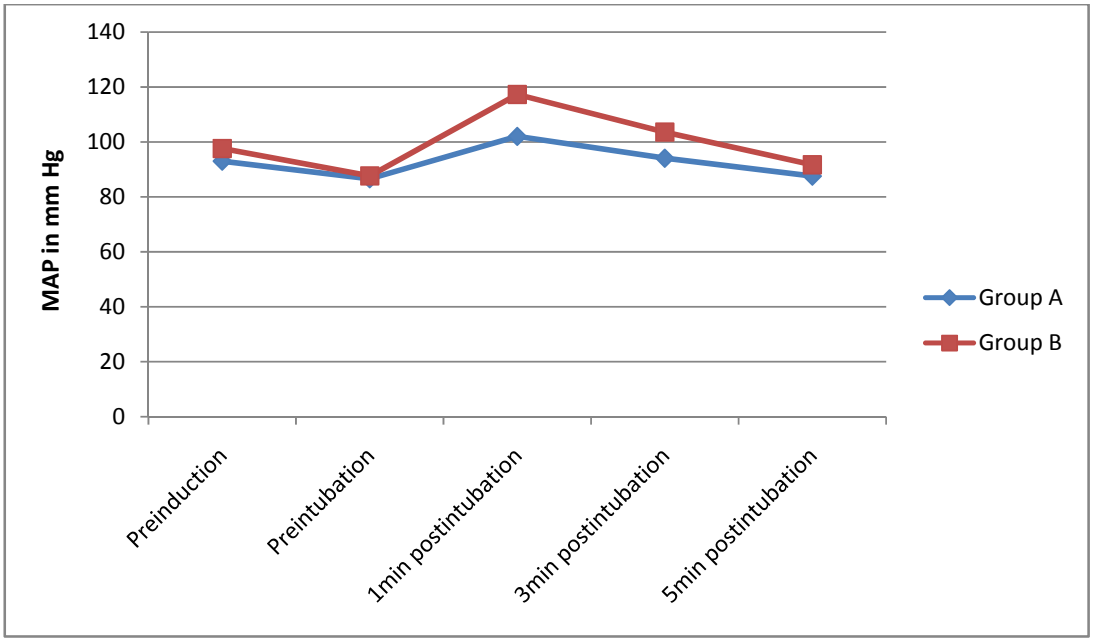
Heart rate changes



Systolic BP changes



Diastolic BP changes



Mean Arterial Pressure changes

The SpO2 changes in the pre and post intubation periods in both the groups was

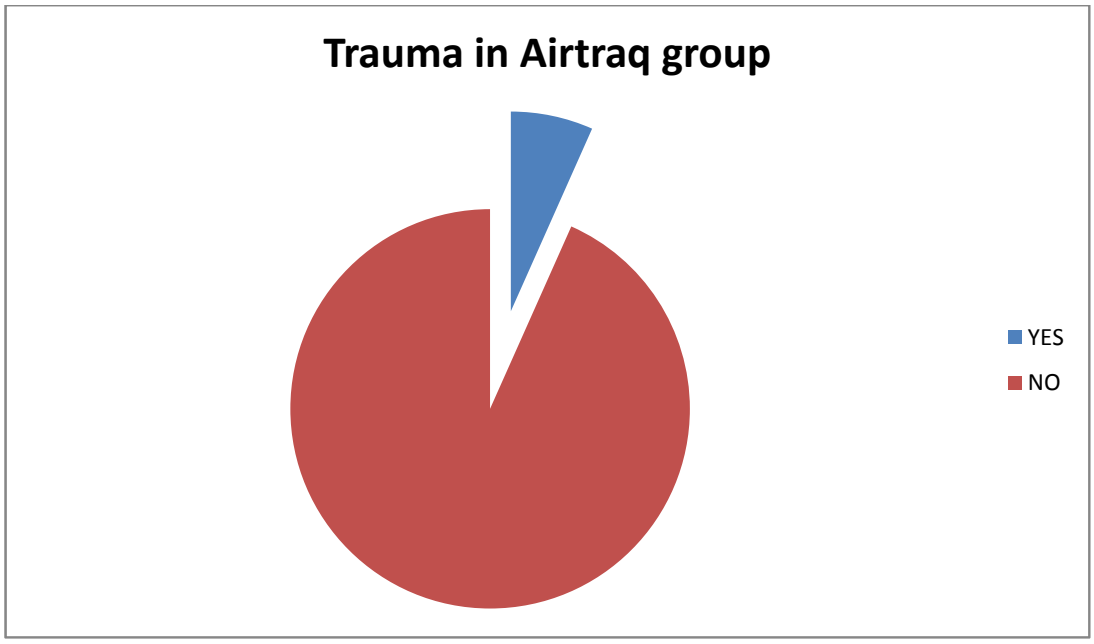
not statistically significant.

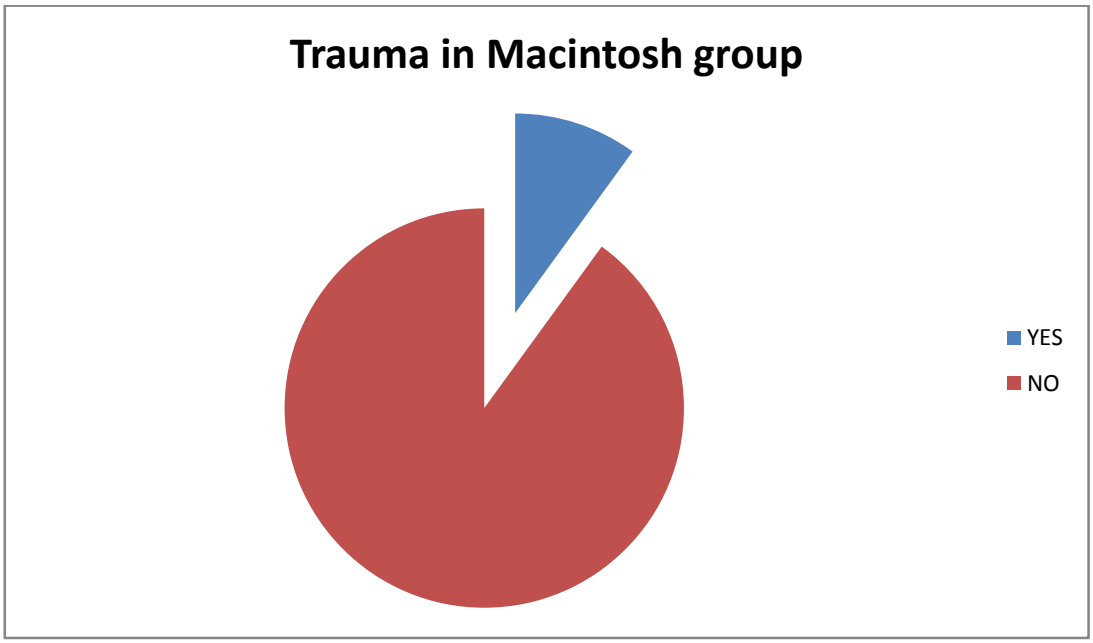
AIRWAY TRAUMA:

2 patients in the Airtraq group and 3 patients in the Macintosh group experienced trauma to the airways and all the injuries were to the soft tissues.

Pearson's Chi – square test:

Group	Trauma		P value
	Yes	No	
Airtraq	2(6.67%)	28(93.33%)	0.64
Macintosh	3(10%)	27(90%)	





OPERATOR GRADING:

The operator graded the ease of intubation in an increasing grade of difficulty from grade 1 to grade 5.

Grade 1 : Easy intubation

Grade 2 : Mild difficulty

Grade 3 : Moderate difficulty

Grade 4 : Extremely difficult

Grade 5 : Cannot intubate

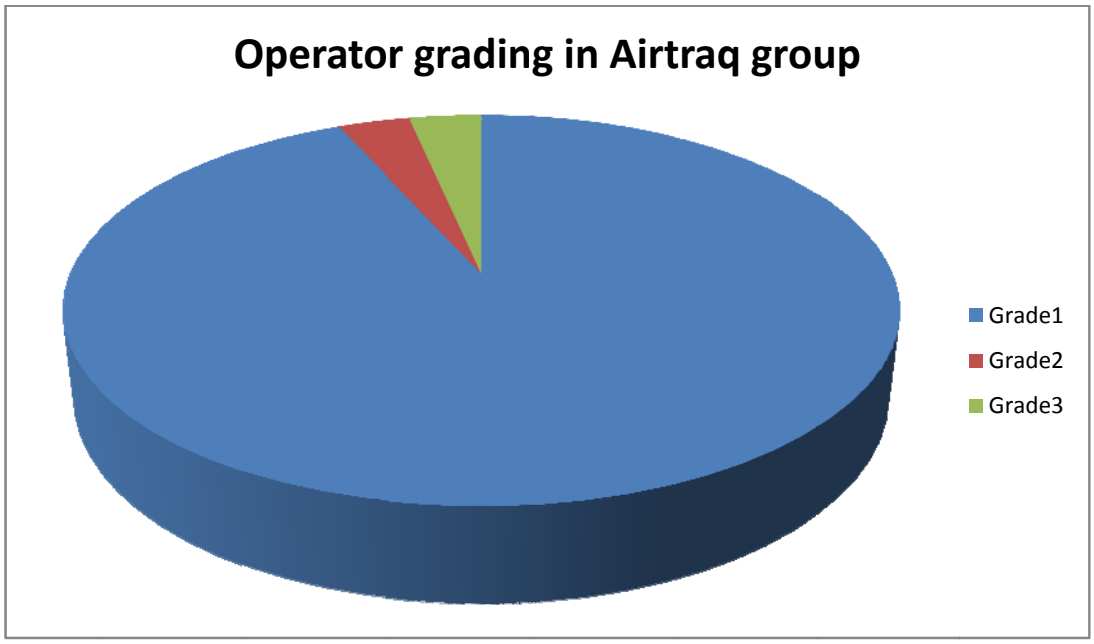
28 patients in the Airtraq group had a grade 1 ease of intubation , compared to 20 patients in the Macintosh group.

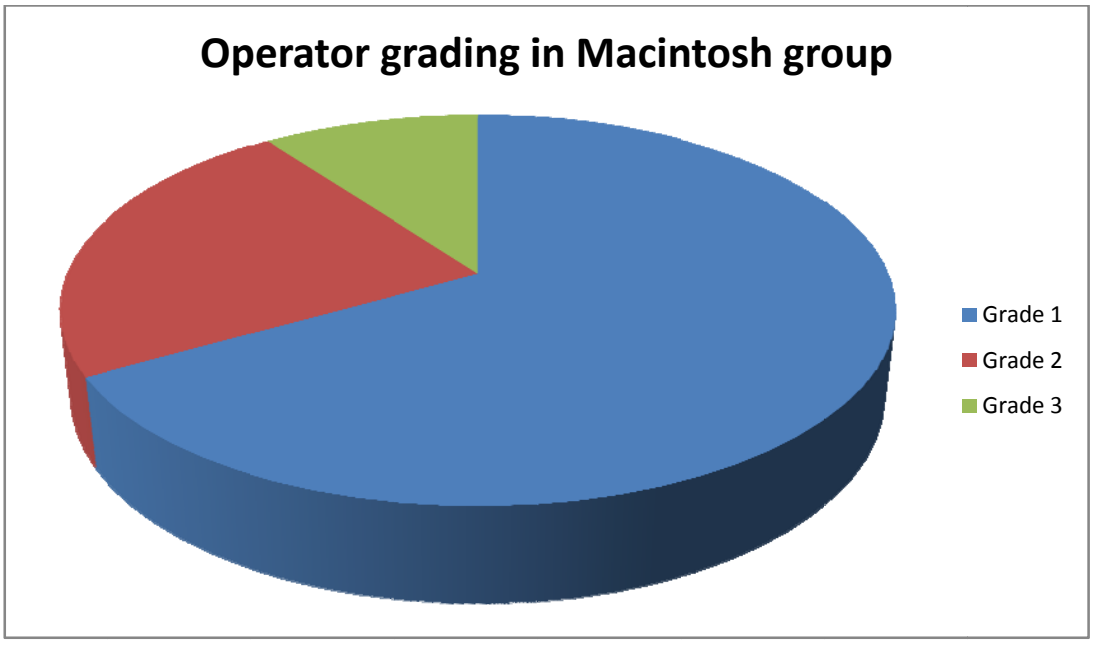
In the Airtraq group 1 patient had a grade 2 ease of intubation, compared to 7 patients in the Macintosh group.

1 patient in the Airtraq group had a grade 3 ease of intubation , compared to 3 patients in the Macintosh group.

Pearson Chi –square test:

Operator Grading	Group		P value
	Airtraq	Macintosh	
1	28(93.33%)	20(66.67%)	0.033
2	1(3.33%)	7(23.33%)	
3	1(3.33%)	3(10%)	
4	0(0%)	0(0%)	
5	0(0%)	0(0%)	


Operator grading in Airtraq group
Grade1
Grade2
Grade3


Operator grading in Macintosh group
Grade 1
Grade 2
Grade 3

DISCUSSION

Expert airway management is an essential skill of an Anaesthesiologist.

Difficulties with tracheal intubation are mostly caused by difficult direct laryngoscopy with impaired view to the vocal cords[31]. Unfortunately, despite all the information currently available, no single factor reliably predicts these difficulties[32].

Consequently, many difficult intubations will not be recognized until after induction of anaesthesia. Unanticipated difficult intubation can lead to critical situations, especially in those patients who are at risk for gastric regurgitation, who are difficult to ventilate by mask or who have limited cardiopulmonary reserves.

When a person is in supine position and head in neutral position, the laryngeal axis is almost horizontal. The pharyngeal axis is approximately 30 – 45^0 from the horizontal axis and the oral axis almost perpendicular to the laryngeal axis[33].

Successful direct laryngoscopy for the exposure of the glottis opening requires the alignment of oral, pharyngeal and laryngeal axes. Elevation of head about 10 cm with pads below the occiput aligns the laryngeal and pharyngeal axes.

Subsequent head extension at the atlanto occipital joint creates the shortest distance and most nearly straight line from the incisors to glottic opening.

The degree of head and neck movements that can facilitate intubation with conventional aids are:

- Head extension > 80 – 85^0
- Neck flexion > 25 – 30^0
- Head/neck rotation > 70 – 75^0
- Normal lateral bending movements at cervical spines
  Include 5 – 10^0 at each cervical spine below C2 level.

Presence of factors like Ankylosing spondylitis, Rheumatoid arthritis, Cervical spine fusion, Cervical spondylitis, Cervical spine injuries, Scleroderma, Fibrosis of neck region due to burns will prevent ideal positioning and intubation may be difficult with conventional aids.

Many endoscopic intubation laryngoscopes such as the Bullard laryngoscope, the Upsher laryngoscope, the Wuscope and the Airtraq laryngoscope have been designed to visualize the vocal cords through a proximal viewfinder that overcomes the curved anatomical axis by prism or mirror. They have been found to be useful in situations where conventional

laryngoscopy fails to get desired laryngeal view. Trial reports so far have shown improvement in laryngeal view and ease of intubation.

The advantages of Airtraq laryngoscope from the available literatures include[34,35,36]:

- As the axis of Airtraq laryngoscope is curved and the image is transmitted through lenses and mirrors, the alignment of the axes may not be needed – improved intubating conditions in patients.
- Useful when there is altered anatomy and when contraindications for Magill's positioning are present.
- The displayed anatomy is magnified.
- Recognition of the anatomical structures and anomalies is easier.
- Since fewer manipulations of the airway is needed, it is associated with fewer hemodynamic changes during intubation.
- Significantly reduces the duration of intubation.
- A clip-on wireless video system is also available which allows viewing on an external screen. This may be particularly useful for teaching purposes.
- Shortens the learning curve in novice personnel learning to intubate.

Our study was designed to compare the intubating conditions of Airtraq laryngoscope with conventionally used Macintosh laryngoscope. 60 patients were randomly selected and included in the study.

INTUBATION DIFFICULTY SCORE[37]:

Intubation difficulty score was used to evaluate intubating conditions. It was developed by Adnet et al in 1997. It is a blend of subjective and objective criteria that permit a qualitative and quantitative approach to the progressive nature of the difficulty in intubation and appears to be the best indicator till date.

In this scale, the value of IDS is '0' if full visualization of the laryngeal aperture is possible during laryngoscopy and vocal cords are seen to be nicely abducted. Each variation from this defined 'ideal' intubation increases the degree of difficulty, the overall score being the sum of all variations from the definition.

It was generally easy to insert the Airtraq laryngoscope, to obtain a full view of the glottis, and to intubate the trachea without major complications. In this device, the tracheal tube can be attached to the side of the blade and the tip of the tube is visible on the viewfinder. Once the glottis was positioned in the centre of the viewfinder, it was easy to advance the tube into the trachea.

There was one difficulty though. Inserting the Airtraq too close to the glottis will only allow the initial posterior movement of the tube and result in a failure to intubate. The 'back and up manoeuvre' which involves withdrawing the device away from the glottis and lifting the device up before attempting to intubate helps to overcome this problem.

In our study the following parameters where observed:

- In only one patient supplementary attempt (N1 = 1) was used in both the groups.
- In 2 patients supplementary operators (N2) were needed for intubation in Airtraq group compared to only 1 patient in Macintosh group.
- No patient required alternative intubation techniques(N3) in Airtraq group compared to 4 patients in Macintosh group.
- All patients required normal lifting force during laryngoscopy(N5 = 0), whereas 7 patients in Macintosh group needed increased lifting force (N5 = 1)
- There was no need for any external laryngeal manipulation(N6) in any of the cases of Airtraq group compared to 12 patients in Macintosh group.
- In all 60 patients the vocal cords were in abducted position (N7)
- Total IDS score of 0 was noted in 28 patients in Airtraq group and 1 patient each had a score of 2 and 3. In the Macintosh group only 13 patients had a total IDS score of 0 and 17 patients with score of 1 and above with a maximum score of 6 in one patient.

In the study conducted by Chrisen H. Maharaj, Elma Buckley, Brian H. Harte and John G. Laffey titled "Endotracheal intubation in patients with cervical spine immobilization-A comparison of Macintosh and Airtraq laryngoscopes" it was found that 14 out of the 20 in Macintosh group had an IDS score of 1 or more, compared with 1 in the Airtraq group. In the Macintosh group 4 patients had an IDS score of 5 or greater, indicating moderate to severe intubation difficulty. These findings are comparable to our study.

IMPROVEMENT IN LARYNGEAL VIEW:

The laryngoscopic view was graded by Cormack and Lehane classification. Cormack and Lehane score (1,2,3,4) with Airtraq was (28,2,0,0) and with Macintosh blade was (13,15,2,0). The difference was statistically significant when analysed with Pearson chi square test and paired T test.

Cormack and Lehane grade of 1 was seen in 93.3% of cases in the Airtraq group which represents best intubating conditions.

This result is comparable to the study titled "Endotracheal intubation in patients with cervical spine immobilization – A comparison of Macintosh and Airtraq laryngoscopes" conducted by Chrisen H.Maharaj et al at the

University College Hospital, Galway, Ireland in which 19 out of the 20 patients intubated with Airtraq had a Cormack and Lehane grade of 1 and 1 patient had a grade of 2 when compared to 6,7,7 patients with CL grade of 1,2 and 3 respectively in the Macintosh group.

DURATION OF INTUBATION ATTEMPT:

The mean time to intubate with the Airtraq group was 11.03 seconds and in the Macintosh group it was 17.2 seconds and it was found to be statistically significant when computed with Levene's test for equality of variances.

In the test conducted by Chrisen Maharaj et al in Ireland in live patients it was 20.3 seconds with Macintosh and 13.2 seconds with the Airtraq laryngoscopes.

In a different study conducted by Maharaj et al in manikins it was found that the time for intubation with the macintosh group was 14.2 seconds and in the Airtraq group it was 9.5 seconds.

In a study conducted by S.K.Ndoko et al in the Jean Verdler Public University Hospital, France in 106 morbidly obese patients the mean time to intubate using Airtraq was 24 seconds and with Macintosh laryngoscope was 56 seconds.

All the above studies demonstrate that Airtraq considerably reduces the time to intubate the patients.

HEMODYNAMIC CHANGES:

The mean increase in heart rate from the preintubation values was 15 per min at 1 min post intubation in the Airtraq group and 27 per min in the Macintosh group.

The mean increase in Mean arterial pressure from the preintubation values was 15 mm Hg in the Airtraq group and 29 mm Hg in the Macintosh group at 1 min post intubation.

The above findings suggest that the Airtraq resulted in less stimulation of heart rate and blood pressure after tracheal intubation in comparison with the Macintosh laryngoscope. This finding probably reflects the fact that the Airtraq provides a view of the glottis without a need to align the oral, pharyngeal and tracheal axes and therefore requires less force to be applied during laryngoscopy. These findings were similar to those obtained in the study conducted by Chrisen H.Maharaj et al in Ireland.

The potential of the Airtraq to produce less stimulation of heart rate and blood pressure may be particularly advantageous in clinical situations such as coronary artery disease or arrhythmias.

AIRWAY TRAUMA:

Minor degree of airway trauma was noted in 2 out of the 30 patients in the Airtraq group and 3 out of the 30 patients in the Macintosh group. All injuries were to the soft tissues. These findings were not statistically significant.

In the study conducted by Maharaj et al it was found that intubation attempts with Airtraq significantly reduced the incidence of airway trauma in Laerdal Airway Trainer and SimMan Manikin in easy and simulated difficult airway scenarios when compared to Macintosh laryngoscope.

Acute traumatic complications like injury to the lips, tongue, nose, pharynx, larynx and trachea can occur during laryngoscopy and intubation. Traumatic complications have been extensively described in two excellent reviews.

1. Weber S. Traumatic complications of airway management., Anaesthesiology clinics of North America 2002;20:503-512.
2. Loh KS, Irish JC. Traumatic complications of intubation and other airway management procedures.Anaesthesiology 2002;20: quoting that " Minor trauma to the airway is common and incidence increases with increasing duration, increasing grade of difficulty, female gender and > 60 yrs of age. Most traumatic complications do not result in major morbidity or mortality. However, some require immediate recognition and management."

SUMMARY

Airtraq laryngoscope significantly improves laryngeal exposure and facilitates rapid, easy and reliable intubation.

It can be useful in routine anaesthesia care and also in anticipated and unanticipated difficult intubation scenarios.

The reduction in hemodynamic changes during laryngoscopy can be useful in patients with coronary artery disease and arrhythmias.

It significantly reduces the learning curve in novice laryngoscopists and the provision for additional video attachment also helps in this regard.

It can be considered that the Airtraq will be a useful addition to the range of difficult airway devices available and it may obviate the need for more sophisticated and complex airway instruments like flexible fiber optic bronchoscope to a particular extent.

CONCLUSION

In conclusion, the Airtraq laryngoscope offers a new approach to tracheal intubation of patients with anticipated and unanticipated difficult airway. The Airtraq reduced the difficulty of tracheal intubation and the degree of hemodynamic stimulation compared with the Macintosh laryngoscope. These findings demonstrate the efficacy of the Airtraq in many clinically relevant contexts and adds to the evolving body of knowledge regarding this potentially useful device.

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PROFORMA

PROSPECTIVE COMPARISON OF INTUBATING CONDITIONS WITH AIRTRAQ LARYNGOSCOPE AND MACINTOSH LARYNGOSCOPE IN RANDOMLY SELECTED ELECTIVE ADULT SURGICAL PATIENTS

NAME : AGE: SEX: I.P.No:

DIAGNOSIS: SURGERY PLANNED:

INTUBATED WITH:

PREOPERATIVE ASSESSMENT:

HISTORY:

CO-MORBID ILLNESS & TREATMENT DETAILS:

EFFORT TOLERANCE- _____ METS

H/O PREVIOUS SURGERY(ANY DOCUMENTED DIFFICULT AIRWAY)-

H/O TRAUMA/BURNS/TUMOURS INVOLVING AIRWAY-

H/O SNORING-

H/O VOICE CHANGE-

GENERAL EXAMINATION:

HEIGHT: WEIGHT: BMI:

ANAEMIA- JAUNDICE- CERVICAL SPINE- TONGUE-

PULSE- BP- CVS- RS-

AIRWAY EXAMINATION:

GROSS ALTERATION IN AIRWAY ANATOMY:

HAIR BUN: YES/NO BEARD: YES/NO

NECK FLEXION: $>25^0/<25^0$ NECK EXTENSION: $>80^0/<80^0$

INTER INCISOR DISTANCE: >3cm/<3cm THYROMENTAL DISTANCE: >6cm/<6cm

UPPER LIP BITE TEST; I/II/III NECK CIRCUMFERANCE:

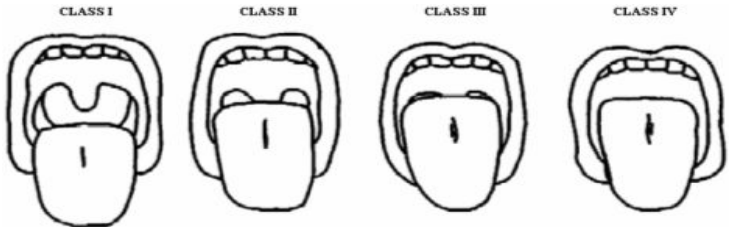
RECEDING MANDIBLE: None/Mod/Sev PALATE CONFIGURATION:Narrow/Normal

DENTURES:

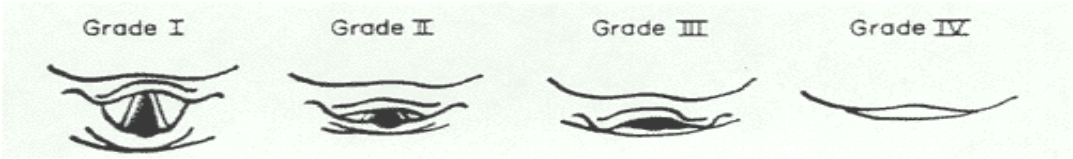
ARTIFICIAL (REMOVABLE/FIXED): YES/NO BUCK TEETH: None/Mod/Sev

LOOSE TEETH : YES/NO CRACKED TEETH : YES/NO ABSENT TEETH : YES/NO

MODIFIED MALLAMPATTI CLASSIFICATION (MARK-0)



CORMACK & LEHANE GRADING:



INTUBATION DIFFICULTY SCORE:

1. NUMBER OF ATTEMPTS:
2. NUMBER OF SUPPLEMENTARY OPERATORS:
3. NUMBER OF ALTERNATIVE TECHNIQUES: (change of blade/ use of bougie):
4. CORMACK & LEHANE GRADE minus 1:
5. LIFTING FORCE:
6. EXTERNAL LARYNGEAL MANIPULATION: (needed/not needed):
7. POSITION OF VOCAL CORDS: (abducted/adducted):

N1	N2	N3	N4	N5	N6	N7

DURATION: _____ SECONDS

OPERATOR GRADING OF EASE OF INTUBATION : 1 – 2 – 3 – 4 – 5

VITAL PARAMETERS:

		PR	BP	SPO2
PRE INDUCTION (30 SECS)				
PREINTUBATION (30 SECS)				
POST INTUBATION	1 min			
	3 min			
	5 min			

PATIENT CONSENT FORM

STUDY TITLE: Prospective, randomized comparison of intubating conditions with Airtraq laryngoscope & Macintosh laryngoscope in randomly selected elective adult surgical patients.

STUDY CENTRE: Institute of Anaesthesiology & Critical Care, Madras Medical College.

PARTICIPANT NAME: **AGE:** **SEX:**

I.P.NO:

I confirm that I have understood the purpose of procedure for the above study. I had the opportunity to ask questions and all my questions and doubts have been answered to my satisfaction.

I have been explained about the possible complications that may occur during the procedure like traumatic injury to the throat. I understand that every precaution will be taken to prevent such an injury and if it happens will be treated accordingly. I have been informed that no other major complication has been reported so far with the use of Airtraq.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason.

I understand that investigator, regulatory authorities and the Ethics committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from the study.

I hereby consent to participate in this study of comparison of intubating conditions with Airtraq and Macintosh laryngoscope.

Time:

Date: Signature/ Thumb impression of patient

Place: Patient name: _____

Signature of the investigator:

Name of the investigator :

GROUP	S.NO	NAME	AGE	SEX	SURGERY
A	1	CHINNASAMY	61	MALE	LUMBAR LAMINECTOMY
A	2	USHA	43	FEMALE	CRANIOTOMY
A	3	PREMKUMAR	25	MALE	CRANIOTOMY
A	4	JAGADEESAN	30	MALE	CRANIOTOMY
A	5	PREMKUMAR	23	MALE	BURR HOLE
A	6	MARIMUTHU	56	MALE	LUMBAR LAMINECTOMY
A	7	ARUNACHALAM	50	MALE	CRANIOTOMY
A	8	PREMKUMAR	28	MALE	CRANIOTOMY
A	9	RAMESH	24	MALE	DEPRESSED FRACTURE
A	10	PARIMELALAGAN	19	MALE	CRANIOTOMY
A	11	RAMESH	33	MALE	CRANIOTOMY
A	12	MAHESH KUMAR	23	MALE	ACF- REPAIR
A	13	VEERAN	42	MALE	CORPECTOMY AND STABILISAT
A	14	CHENGAMALAM	28	MALE	CRANIOTOMY
A	15	PERIASAMY	25	MALE	CRANIOTOMY
A	16	ELUMALAI	35	MALE	BONY TUMOR EXCISION
A	17	MARIAMBANU	36	FEMALE	LUMBAR LAMINECTOMY
A	18	DHARMALINGAM	55	MALE	VP SHUNT
A	19	AMARNATH	28	MALE	LUMBAR LAMINECTOMY
A	20	ETTIAPPAN	65	MALE	LUMBAR LAMINECTOMY
A	21	VIVEGA	18	FEMALE	CRANIOTOMY
A	22	SETTU	35	MALE	CYSTOPERITONEAL SHUNT
A	23	LALITHA	40	FEMALE	VP SHUNT
A	24	GIRIBABU	19	MALE	LUMBAR LAMINECTOMY
A	25	SIVAGAMI	43	FEMALE	CRANIOTOMY
A	26	SANGITA	32	FEMALE	VP SHUNT
A	27	SHANKAR	60	MALE	CRANIOTOMY
A	28	RAVIKUMAR	24	MALE	VP SHUNT
A	29	SRINIVASAN	56	MALE	CRANIOPLASTY
A	30	MEENA	43	FEMALE	BONY TUMOR EXCISION
B	31	SAKUNTHALA	40	FEMALE	VP SHUNT
B	32	KUMAR	29	MALE	CRANIOTOMY
B	33	SUREKHA	29	FEMALE	FLAP COVER
B	34	LAKSHMANAN	42	MALE	LUMBAR LAMINECTOMY
B	35	ANNAMUTHU	37	MALE	D10-L3 SCHWANNOMA-EXCISI
B	36	MAHENDRARAJU	27	MALE	LUMBAR LAMINECTOMY
B	37	NAVEEN	19	MALE	CIRSOID ANEURYSM LIGATION
B	38	AMARNATH	28	MALE	REDO LAMINECTOMY
B	39	VENU	50	MALE	CRANIOTOMY
B	40	MUTHU	32	MALE	CRANIOPLASTY
B	41	SIVAGAMI	48	FEMALE	CRANIOTOMY
B	42	SAROJA	60	FEMALE	CRANIOTOMY
B	43	DEVI	21	FEMALE	ENDONASAL EXCISION
B	44	SAKUNTHALA	40	FEMALE	CRANIOTOMY
B	45	SELVI	48	FEMALE	LUMBAR LAMINECTOMY

B	46	KUBERAN	30	MALE	LUMBAR LAMINECTOMY
B	47	CHITHRAKUMAR	33	MALE	CRANIOTOMY
B	48	PERUMAL	60	MALE	CRANIOTOMY
B	49	REKHA	22	FEMALE	CRANIOTOMY
B	50	BHARATHI	25	FEMALE	CRANIOTOMY
B	51	NIRMALADEVI	41	FEMALE	LUMBAR LAMINECTOMY
B	52	USMAN	55	MALE	LUMBAR LAMINECTOMY
B	53	SARALA	32	FEMALE	VP SHUNT
B	54	KAMATCHI	59	FEMALE	CRANIOTOMY
B	55	RAJESH	25	MALE	CRANIOTOMY
B	56	ARUN	27	MALE	CRANIOTOMY
B	57	VEERAPANDIAN	54	MALE	CRANIOPLASTY
B	58	SIVAKUMAR	22	MALE	VP SHUNT
B	59	PANDURANGAN	33	MALE	SCHWANNOMA EXCISION
B	60	RANGASAMY	54	MALE	LUMBAR LAMINECTOMY

Ht(cm)	Wt(kg)	BMI	MPC	N1	N2	N3	N4	N5
155	50	20.8	2	0	0	0	0	0
150	50	22.22	2	0	0	0	0	0
162	80	30.48	2	0	0	0	0	0
162	55	20.95	2	0	0	0	0	0
173	65	21.71	1	0	0	0	0	0
158	59	23.63	2	0	0	0	0	0
165	60	22.03	2	0	0	0	0	0
162	80	30.48	2	0	0	0	0	0
165	60	22.03	1	0	0	0	0	0
169	65	22.76	1	0	0	0	0	0
175	72	23.51	2	0	0	0	0	0
155	55	22.9	1	0	0	0	0	0
162	70	26.67	2	0	0	0	0	0
172	70	23.66	2	0	0	0	0	0
172	82	27.72	2	0	0	0	0	0
170	85	29.41	2	0	0	0	0	0
155	78	32.46	2	0	0	0	0	0
155	80	33.3	1	0	0	0	0	0
172	80	27.04	1	0	0	0	0	0
161	76	29.32	2	0	0	0	0	0
145	42	19.98	1	0	0	0	0	0
163	65	24.46	1	0	0	0	0	0
155	55	22.9	1	0	0	0	0	0
170	65	22.49	1	0	0	0	0	0
165	75	27.54	2	0	1	0	1	0
158	55	22.03	1	0	0	0	0	0
162	88	33.53	3	1	1	0	1	0
178	65	20.51	2	0	0	0	0	0
154	78	32.89	2	0	0	0	0	0
153	46	19.65	1	0	0	0	0	0
152	60	25.97	2	0	0	0	1	0
160	70	27.34	2	1	1	1	1	1
152	45	19.48	1	0	0	0	1	0
165	60	22.04	1	0	0	0	1	1
165	68	24.98	1	0	0	0	0	0
163	85	31.99	2	0	0	1	1	1
158	60	24.03	1	0	0	0	0	0
172	73	24.67	1	0	0	0	1	0
167	65	23.3	1	0	0	0	0	0
175	65	21.22	1	0	0	0	0	0
152	45	19.48	1	0	0	1	2	1
156	70	28.76	2	0	0	0	0	0
155	55	22.89	1	0	0	0	1	0
151	52	22.8	2	0	0	0	1	0
155	68	28.3	1	0	0	0	0	0

172	80	27.04	1	0	0	0	0	0
165	62	22.77	2	0	0	0	0	0
163	65	24.46	2	0	0	0	1	0
152	58	25.1	1	0	0	0	0	0
148	40	18.26	1	0	0	0	1	0
163	80	30.11	1	0	0	0	0	0
175	90	29.38	1	0	0	0	1	0
153	65	27.77	1	0	0	0	1	1
153	60	25.63	2	0	0	0	1	1
175	70	22.86	2	0	0	0	0	0
167	58	20.79	1	0	0	0	1	0
168	78	27.64	2	0	0	1	2	1
175	68	22.2	1	0	0	0	0	0
168	75	26.57	1	0	0	0	0	0
172	65	21.97	1	0	0	0	1	0

N6	N7	TOTAL N	Duration (sec)	Operator grading	PREINDUCTION HR	Sys BP	Diast BP	MAP
0	0	0	13	1	84	112	72	85
0	0	0	14	1	92	115	84	94
0	0	0	11	1	90	142	90	107
0	0	0	8	1	104	124	84	97
0	0	0	6	1	68	130	80	97
0	0	0	7	1	59	114	74	87
0	0	0	12	1	60	109	76	87
0	0	0	8	1	90	142	90	107
0	0	0	11	1	83	103	78	86
0	0	0	6	1	65	91	69	76
0	0	0	8	1	85	138	93	108
0	0	0	6	1	88	119	73	88
0	0	0	10	1	82	92	62	72
0	0	0	7	1	88	110	79	89
0	0	0	7	1	75	119	84	96
0	0	0	6	1	92	140	87	105
0	0	0	8	1	71	131	82	99
0	0	0	9	1	91	108	73	85
0	0	0	18	1	80	148	102	117
0	0	0	8	1	94	124	73	90
0	0	0	10	1	112	98	63	75
0	0	0	7	1	61	110	72	85
0	0	0	9	1	83	119	69	86
0	0	0	13	1	78	134	89	104
0	0	2	25	2	94	114	70	85
0	0	0	12	1	78	112	74	87
0	0	3	35	3	102	145	95	112
0	0	0	12	1	87	132	88	103
0	0	0	11	1	85	128	83	98
0	0	0	14	1	70	112	68	83
1	0	2	14	1	90	152	104	120
1	0	6	25	2	85	114	73	87
1	0	2	18	2	112	120	81	94
0	0	2	16	1	128	150	90	110
0	0	0	14	1	102	112	72	85
1	0	4	32	3	112	152	102	115
0	0	0	15	1	94	92	61	71
1	0	2	23	2	77	142	92	108
0	0	0	12	1	71	142	92	108
0	0	0	13	1	85	110	70	83
1	0	5	25	3	105	119	78	92
0	0	0	12	1	107	150	103	119
0	0	1	11	1	86	109	68	82
1	0	2	19	2	94	136	95	109
0	0	0	13	1	89	130	82	98

0	0	0	21	1	82	112	75	87
0	0	0	12	1	83	101	71	81
0	0	1	16	1	65	102	62	75
0	0	0	12	1	89	118	63	81
1	0	2	16	1	84	94	68	77
0	0	0	15	1	72	132	85	101
1	0	2	18	1	58	142	103	116
1	0	3	21	2	110	132	84	100
1	0	3	21	2	72	153	95	114
0	0	0	18	1	114	124	81	95
0	0	1	18	1	86	132	84	100
0	0	4	23	3	78	142	95	111
0	0	0	10	1	65	132	83	99
0	0	0	14	1	78	138	87	104
1	0	2	19	2	89	132	95	107

PREINTUBATION					1 MIN POST IN			
SPO2	*HR*	*Sys BP*	*Diast BP*	*MAP*	*SPO2*	*HR*	*Sys BP*	*Diast BP*
100	82	105	63	77	100	103	125	79
100	97	107	71	83	100	112	129	96
100	92	130	100	110	100	98	134	102
100	107	130	86	99	100	114	144	101
100	85	134	88	103	100	101	150	94
100	69	94	69	77	100	75	112	83
100	71	108	74	85	100	68	128	90
100	92	130	100	110	100	98	134	102
100	92	105	81	89	100	99	109	85
100	69	102	63	76	100	72	106	72
100	92	122	83	96	100	101	135	95
100	87	97	67	77	100	98	109	71
100	80	95	63	74	100	89	102	69
100	82	95	60	72	100	101	115	81
100	74	121	86	98	100	81	132	91
100	86	135	78	97	100	98	146	92
100	75	112	73	86	100	82	122	81
100	83	92	68	76	100	98	104	86
100	89	144	91	109	100	119	172	118
100	99	105	67	80	100	121	128	84
100	102	90	59	69	100	128	108	82
100	72	92	63	73	100	83	107	72
100	81	108	63	78	100	91	121	74
100	85	125	85	98	100	119	156	97
100	102	100	65	77	100	129	134	95
100	87	102	69	80	100	103	128	87
100	108	124	78	93	100	143	165	112
100	94	123	81	95	100	118	145	97
100	91	114	68	83	100	112	138	89
100	81	104	63	77	100	108	132	83
100	83	149	94	112	100	108	163	108
100	82	102	69	80	100	108	139	93
100	111	111	73	86	100	132	154	104
100	114	144	88	107	100	131	171	108
100	94	104	63	77	100	121	121	69
100	106	151	93	112	100	132	182	121
100	99	94	64	74	100	112	114	72
100	82	131	81	98	100	118	173	108
100	68	118	73	88	100	92	162	121
100	89	94	65	75	100	125	124	94
100	111	108	64	79	100	135	158	104
100	102	134	85	101	100	128	165	119
100	101	91	57	68	100	121	115	78
100	72	112	68	83	100	102	171	102
100	100	124	74	91	100	126	162	103

100	77	121	82	95	100	98	159	102
100	81	92	63	73	100	111	138	92
100	61	93	59	70	100	92	132	93
100	92	105	61	76	100	121	142	95
100	94	85	59	68	100	122	125	87
100	71	121	79	93	100	98	162	103
100	67	138	99	112	100	99	172	123
100	100	94	67	76	100	125	152	103
100	75	112	72	85	100	105	165	112
100	108	102	63	76	100	132	142	95
100	93	121	75	90	100	121	149	102
100	83	133	84	100	100	145	165	112
100	71	118	72	87	100	101	146	95
100	83	126	81	96	100	105	143	89
100	95	126	89	101	100	127	158	108

TUBATION			3 MIN POST INTUBATION					5 MIN
MAP	*SPO2*	*HR*	*Sys BP*	*Diast BP*	*MAP*	*SPO2*	*HR*	*Sys BP*
94	100	93	114	71	85	100	81	108
107	100	93	115	85	95	100	87	109
112	100	99	128	85	99	100	92	125
115	100	108	137	82	100	100	101	110
113	100	98	142	88	106	100	88	134
93	100	65	108	69	82	100	59	102
103	100	74	133	91	105	100	70	123
113	100	99	128	89	102	100	92	121
93	100	93	103	81	88	100	87	101
83	100	73	103	70	81	100	68	96
108	100	92	121	81	94	100	85	117
84	100	84	97	68	78	100	88	102
80	100	81	93	61	72	100	83	95
92	100	99	112	81	91	100	81	117
105	100	70	124	93	103	100	75	122
110	100	92	144	94	111	100	93	132
91	100	73	111	72	85	100	75	108
92	100	92	112	89	97	100	81	116
136	100	105	162	102	122	100	95	134
99	100	97	108	69	82	100	92	102
91	100	114	102	73	83	100	102	93
84	100	71	101	65	77	100	65	97
90	100	83	111	63	79	100	81	108
117	100	92	147	98	116	100	87	126
108	100	112	121	87	98	100	98	108
101	100	90	114	78	90	100	77	105
130	97	122	148	102	117	100	98	134
113	100	105	132	91	105	100	91	118
105	100	101	124	76	92	100	89	112
99	100	99	118	71	87	100	83	107
126	100	101	141	93	109	100	90	136
108	97	92	121	81	94	99	83	108
121	100	118	132	94	107	100	108	118
129	100	108	164	102	123	100	94	152
86	100	108	105	61	76	100	93	102
141	97	122	161	113	129	100	108	142
86	100	98	102	68	79	100	92	98
130	100	101	158	93	115	100	91	143
135	100	81	143	91	108	100	72	131
104	100	104	114	81	92	100	91	110
122	100	112	128	92	104	100	108	104
134	100	112	152	102	119	100	101	142
90	100	112	111	75	87	100	103	109
125	100	81	161	103	122	100	72	133
123	100	133	151	91	111	100	102	132

121	100	83	132	93	106	100	75	121
107	100	102	124	74	91	100	91	103
106	100	89	112	77	89	100	71	105
111	100	108	121	74	90	100	92	103
100	100	118	102	69	80	100	101	93
123	100	83	142	92	109	100	71	135
139	100	83	152	101	118	100	61	131
119	100	111	112	83	96	100	108	104
130	100	99	149	103	118	100	81	125
111	100	118	121	83	96	100	104	108
118	100	108	133	93	106	100	87	122
130	100	131	148	105	119	100	114	132
112	100	87	135	86	102	100	73	121
107	100	91	137	83	101	100	81	126
125	100	108	143	97	112	100	91	132

POST INTUBATION			TRAUMA
Diast BP	*MAP*	*SPO2*	*(Y/N)*
63	78	100	N
79	89	100	N
81	96	100	N
69	83	100	N
86	102	100	N
76	85	100	N
83	96	100	N
83	96	100	N
79	86	100	N
58	67	100	N
75	89	100	N
69	80	100	N
66	76	100	N
79	92	100	N
86	98	100	N
91	105	100	N
69	82	100	N
89	98	100	N
92	106	100	N
71	81	100	N
59	70	100	N
61	73	100	N
61	77	100	N
84	98	100	N
75	86	100	Y
67	80	100	N
91	105	100	Y
72	87	100	N
71	85	100	N
67	A	100	N
91	106	100	N
62	77	100	N
75	89	100	N
93	113	100	N
60	74	100	N
92	109	100	Y
64	75	100	N
93	110	100	N
85	100	100	N
68	82	100	N
72	83	100	Y
93	109	100	N
79	89	100	N
85	101	100	N
85	101	100	N

75	90	100	N
65	78	100	N
63	77	100	N
61	75	100	N
61	72	100	N
87	103	100	N
83	99	100	N
75	85	100	N
79	94	100	N
71	83	100	N
75	91	100	N
87	102	100	Y
75	90	100	N
75	92	100	N
87	102	100	N